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# Results of Bacterial Plate Counts of Milk on Three Media and at Two Temperatures of Incubation

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THE publication of the Seventh Edition of *Standard Methods for the Examination of Dairy Products,* in which is prescribed a change in culture medium from the present standard nutrient agar to a new standard nutrient agar known as tryptone-glucose-extract-milk agar, makes it desirable to present the reasons for this change.

Those who have been active in seeking improvements in the culture medium for the bacteriological plating of milk and dairy products are familiar with the various developments antecedent to the present study conducted by the Committee on Standard Methods for the Examination of Dairy and Food Products. In order that others may understand the motives and objectives of the committee, the following brief history is presented.

## INTRODUCTION

Comparative studies with agars of different composition and with different temperatures of incubation were carried out under the auspices of the American Public Health Association before the first edition of *Standard Methods of Milk Analysis* was published in 1910. Again in 1915 Conn [1] conducted a comparative study of plate count results in four laboratories, using two modifications of the standard nutrient agar prescribed by the "Standard Methods Report" of that period. His conclusions were to the effect that the modifications employed in making media had a minor effect upon the plate count, as compared with such other factors as differences in technic. Hatfield [2] and Kilbourne [3] conducted similar studies in 1918 with parallel results.

The composition of the culture medium continued a subject for discussion and study, and important changes were made in the second, third, fourth, and fifth editions. The composition of the agar remained unchanged in the sixth edition, but there was general appreciation of the fact that the agar in use was unsatisfactory in several respects.

In 1934 Bowers and Hucker presented a preliminary report of a study of the effect of the substitution of yeast extract for beef extract in the standard nutrient agar formula, and also of the effect of the addition of a fermentable carbohydrate. The substitution of yeast extract did not materially increase the count, but it was found that the addition of glucose to standard nutrient agar resulted in an appreciable increase in count and also increased the colony size. In March, 1935, these authors published a report of a more extensive study on the composition of culture media for the bacteriological examination of milk.[5] On the basis of their findings they suggested the use of a medium for the grading of milk by counts, to consist of 0.5 per cent tryptone (a casein digest peptone), 0.1 per cent glucose, 0.5 per cent skim milk, and agar.

In May, 1935, Breed[6] as Chairman of the Committee on Standard Methods of Dairy and Food Products, urged milk control laboratory directors to prepare and use this and other suggested media in comparison with standard nutrient agar.

Since 1921 the literature has been interspersed with discussions of and references to the effect upon bacterial plate counts of milk, of irregularities in the temperature of incubation caused by inefficient incubator construction.[7–13] These led to an organized study of the construction of bacteriological incubators, and the effect of various methods of loading upon the temperatures of individual plates.[14] This work was followed by a study of the effect of carefully controlled specific temperatures ranging from 21°C. to 55°C., upon the plate counts of the same sample of milk.[15] The latter investigators, Pederson and Yale, found that the apices of most of the plotted curves of maximum average plate counts occurred at 32°C ± 2°; and they recommended the adoption of this incubation temperature as the standard. It was pointed out that higher counts are obtained at 32°C., yielding a truer measure of milk quality; that there is a smaller error in counts occasioned by temperature variation in incubators operated at this temperature; and that the constancy of counts on split samples incubated at 32°C. is greater than that of those incubated at 37°C.

It will be observed that these developments in composition of culture media and temperatures of incubation were somewhat coincidental. Proposals for changes in Standard Methods resulting therefrom aroused widespread interest and discussion, both within the milk industry and among milk control authorities, and were the inspiration for a number of studies and reports.[16–19] Meanwhile, independently of these studies on the composition of standard agar, a medium was developed by the American Association of Medical Milk Commissions for the plating of certified milk, and a coöperative study of the effect of this medium as compared with standard nutrient agar on milk plate counts, was conducted and reported.[20]

The studies stimulated by the present Committee on Standard Methods with so-called T-G-M agar (Tryptone-glucose-skim milk agar) were summarized for the committee by Yale.[21] In all of these studies, published and unpublished, a certain number of samples yielded higher counts on the old standard agar. Unpublished experimental work carried out under the auspices of the committee having indicated that a return to the use of beef extract would lessen the number of instances where counts on the old agar were higher, the committee decided to make the studies reported upon in this paper with T-G-E-M agar (Tryptone-glucose-extract-milk agar). As this agar contains the same amount of beef extract as the present standard agar it re-

sembles this agar more closely than does the T-G-M agar. It was also decided to include the A.A.M.M.C. agar, as recommended in its latest formula, in this official study. The latter agar also contains beef extract. Incubation of all plates was to be carried out at 37°C. and at 32°C.

## PART I

### AGAR FORMULAE

The formula of the T-G-E-M agar used in this study was as follows:

| T-G-E-M Agar | | |
|---|---|---|
| Bacto-Tryptone | 5 gm. | |
| Bacto-Beef Extract | 3 gm. | |
| Glucose | 1 gm. | |
| Skim milk | 10 cc. | (where dilutions were greater than 1:10). |
| Agar | 15 gm. | |
| Water | 1,000 cc. | |

Reaction pH 7.0

Then, because of the similarity of the latest form of the A.A.M.M.C. agar, in both composition and reported effect, this medium was also included in the study. The composition of the A.A.M.M.C. agar was:

| | | |
|---|---|---|
| Nutri Peptone | 10 | gm. |
| Beef Extract | 3 | gm. |
| Dextrose | 1 | gm. |
| Salt | 5.0 | gm. |
| Agar | 15 | gm. |
| Water | 1,000 | cc. |

Reaction pH 7.0 to 7.2

The "Tryptone" peptone used in the T-G-E-M agar is a digested casein that has been on the market for a number of years. It has generally been found to be a very satisfactory peptone and was thought to be an especially desirable peptone for use in growing organisms found in milk.

With respect to the temperature of incubation, it was recognized to be the function and obligation of the committee to determine the degree to which the adoption of 32°C. incubation affects counts, and to what extent it would disturb existing concepts of milk quality standards, and to consider the practicability and expediency of the adoption of this temperature of incubation as the standard procedure.

### PRIMARY REQUISITES FOR THE STUDY PROCEDURE

Cone's[17] comments on the findings of Kelly[16] impressed upon the committee the imperative need for uniformity of conditions and procedure in the conduct of this study in a number of public health laboratories. Accordingly, an Outline of Procedure, prescribing adherence to the instructions of Standard Methods, 1934, and amplified by insistence upon the following specific requirements, was formulated:

1. Calibrated pipettes
2. Level marked dilution containers
3. Equipment and materials for determining the reaction of media colorimetrically, or more accurately, if preferred
4. Accurately tempered media (when poured)
5. A 32° C. and a 37° C. incubator maintained at constant temperatures
6. Standardized thermometers
7. A Quebec Colony Counter, or other satisfactory illuminating and counting device
8. Breed-count pipettes, slides, and staining equipment
9. Competent and reliable personnel

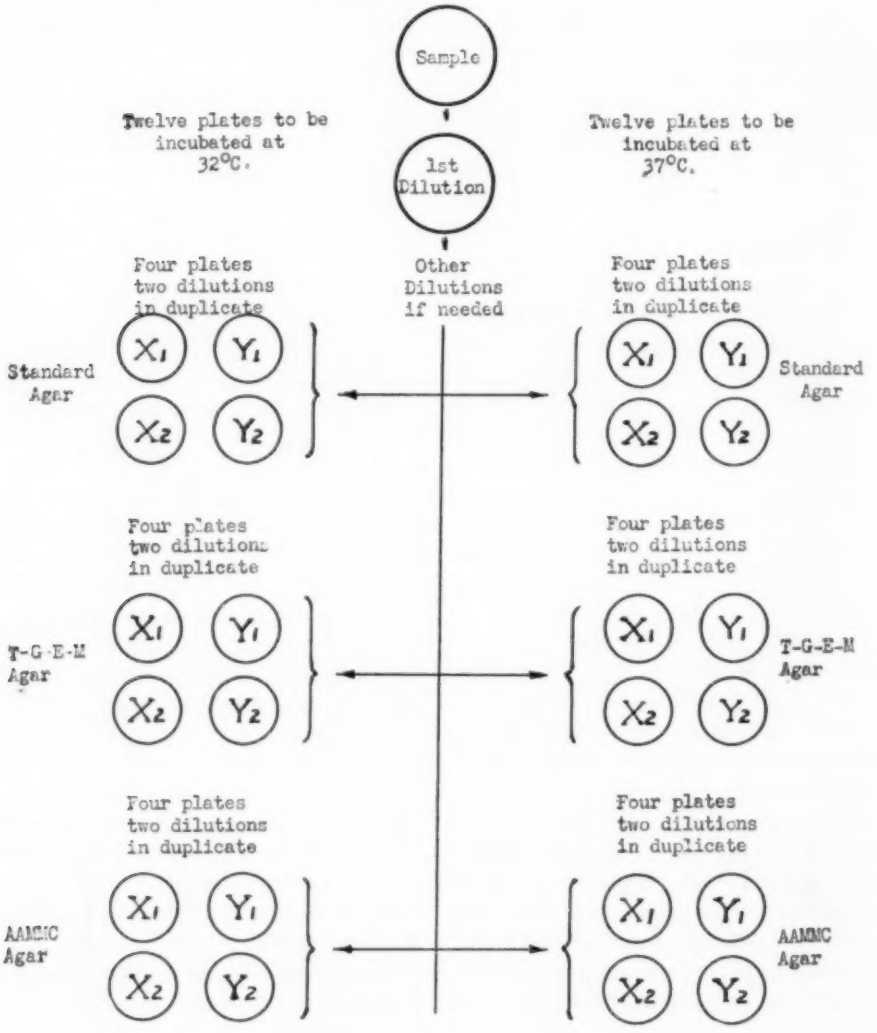
A report-form was devised providing blanks for identification of each sample; its nature, age, and temperature when collected and when plated; type of pipettes and method of dilution employed; reaction and temperature of media when poured; temperature readings of three thermometers kept in the incubators, at intervals during the incubation period; the nature of the counting device used; and, finally, the plate count results. Two sets of plates

of two dilutions each, of each agar and at each temperature under test, were prescribed. The lay-out for any one sample is given in the accompanying schematic chart. (Spaces for reporting dilution counts were lettered on the report form to correspond to the lettered plates in this chart.)

The pouring and counting of two sets of plates was prescribed in order to enable the Referee to judge the accuracy of results in terms of correspondence in count between the duplicate sets of plates, and thus to be in position to discard results of a dubious nature.

SCHEMATIC CHART FOR PLATING SAMPLES

**Instructions:** Use 1.0 cc. of dilution water in each of the "X" plates, whatever the degree of dilution.
Use either 0.1 cc. of the same dilution, or 1.0 cc. of the next higher dilution, in each of the "Y" plates.



### COÖPERATING LABORATORIES

Preliminaries having been completed, the directors of 48 public health laboratories were invited to participate in the study. Although 10 found themselves in position to do so and accepted the invitation, only 7 really participated in the study and filed reports. The numbers and natures of the samples examined by the participating laboratories are given in the Tabulation A.

It is quite obvious that in the cases of raw certified milk, raw certified cream, and pasteurized certified milk, the numbers of sample results submitted are too small to yield analyses of statistical significance. This is true also, though to a lesser extent of raw milk and pasteurized cream. Consequently, the deductions submitted in this report are based mainly upon the analyses of the results of the platings of pasteurized milk.

The laboratories participating in this study (the names of which are purposely not listed in the order in which laboratory designations appear in the tabulations) are:

Bureau of Laboratories, Detroit Department of Health, Detroit, Mich. Dr. Joseph A. Kasper, Director; Gail A. Smith, laboratory medical aid

Division of Bacteriology, New York State Experiment Station (Cornell University), Geneva, N. Y., Dr. G. J. Hucker, Chief in Research; William Walter, Bacteriologist

City Health Department, St. Louis, Mo., Dr. Joseph C. Willett, Chief of Laboratories; J. Lazarov, Bacteriologist

Bureau of Health, Portland, Ore. Dr. Leigh H. Churchill, City Bacteriologist; Wilfred C. Kennell, City Chemist

Bacteriological and Serological Laboratories, Department of Health, Louisville, Ky., Dr. James A. Kennedy, Director; W. L. Williams, Sanitary Bacteriologist

Ontario Department of Health Branch Laboratory, Ottawa, Ont. Dr. Frank S. Letts, Director; J. Baron, Assistant Bacteriologist.

New York State Department of Health, Bureau of Milk Sanitation, W. D. Tiedeman, Chief; N. J. Hohl, Bacteriologist Mobile Laboratory.

TABULATION A

SOURCES AND NATURES OF SAMPLE REPORTS

| *Laboratory* | *Cert. Milk Raw* | *Cert. Cream Raw* | *Milk Raw* | *Milk Past.* | *Cream Past.* | *Cert. Milk Past.* | *Total* |
|---|---|---|---|---|---|---|---|
| A | 0 | 0 | 0 | 15 | 0 | 0 | 15 |
| B | 0 | 0 | 0 | 50 | 12 | 0 | 62 |
| C | 1 | 5 | 23 | 72 | 8 | 0 | 109 |
| D | 11 | 0 | 5 | 21 | 3 | 5 | 45 |
| E | 0 | 0 | 2 | 48 | 0 | 0 | 50 |
| F | 3 | 0 | 1 | 41 | 0 | 0 | 45 |
| G | 0 | 0 | 9 | 0 | 0 | 0 | 9 |
| Totals | 15 | 5 | 40 | 247 | 23 | 5 | 335 |

### VISÉ OF REPORTS RECEIVED

The desirability of checking every report very carefully before classifying and recording the results was indicated before the study had proceeded far. It was also evident that arbitrary rules for deciding upon the results to be used and those to be discarded must be adopted. Because of the fact that the Outline of Procedure formulated for this study prescribed duplicate sets of plates of two dilutions each, the directions for arriving at the final count given in Standard Methods, 1934, do not clearly cover some of the situations encountered. Consequently, the following rules of procedure governing acceptance or rejection of counts, to be applied in addition to those of Standard Methods, were arbitrarily adopted and adhered to:

1. Counts based only upon obviously overgrown (over 400 colonies) or underdeveloped or too highly diluted (less than 20 colonies) plates were to be discarded.

2. When the ratio of the calculated counts on the two plates (X1 and X2, or Y1 and Y2) of either set exceeded 1:2.5, the final count was to be discarded.

3. When the computed final counts of the two sets of plates varied to an extent that the deviation of each from their mean exceeded 25 per cent of the mean, the final count was to be discarded.

The application of these rules, liberal as they may appear, resulted in the discarding of a number of the counts reported. Where necessary, corrections were made of arithmetical errors in the reported counts and to adhere to *Standard Methods of Milk Analysis* procedures.

### NATURE OF THE FINDINGS

Graphic presentation of the results reported, whenever possible and practical, has been followed in the preparation of this report. "Scatter" diagrams on a semi-logarithmic scale, have been employed to demonstrate the dispersion or "scatter" of counts obtained on the several media and at the two temperatures of incubation studied. Every count on standard agar at 37°C. is hypothetically located on the zero abscissa of the chart at the point on the

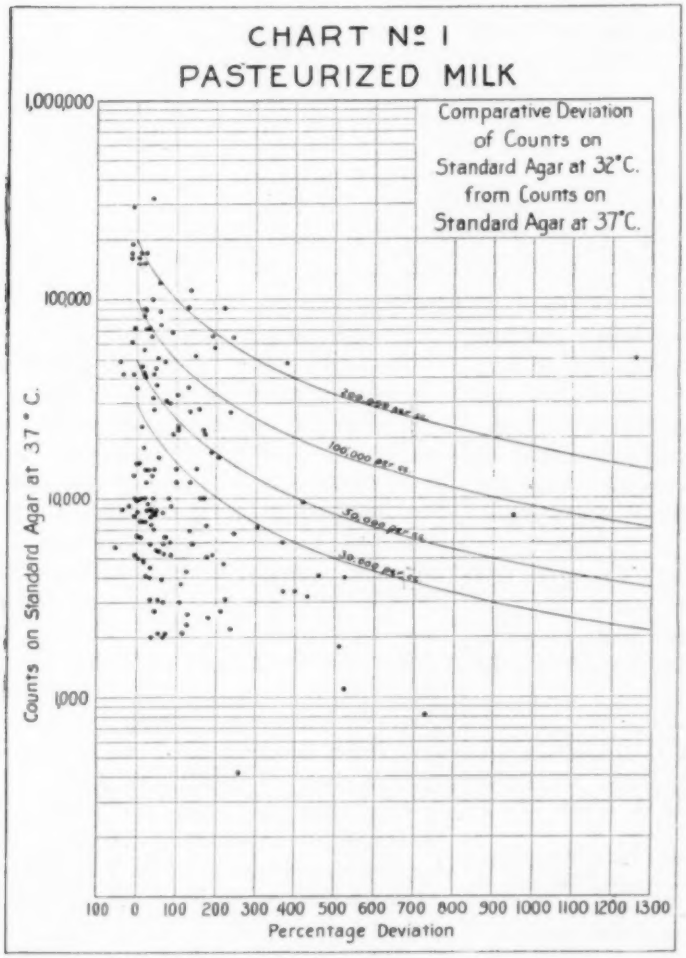


CHART Nº 1
PASTEURIZED MILK
Comparative Deviation of Counts on Standard Agar at 32°C. from Counts on Standard Agar at 37°C.
1,000,000
100,000
10,000
1000
Counts on Standard Agar at 37° C.
100 0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300
Percentage Deviation

CHART No. 1—Deviation of counts on Standard Agar, at 32° C. from those on Standard Agar, at 37° C. 166 Counts. Average deviation: +64.3%.

*Cumulative Deviations:* Counts under 5,000 per cc., +164.0%; under 10,000 per cc., +104.7%; under 25,000 per cc., +95.1%; under 50,000 per cc., +115.4%; under 100,000 per cc., +98.3%; under 200,000 per cc., +70.0%; under 500,000 per cc., +64.3%.

*Counts Exceeding Limit Because of Increase:* 30,000 per cc., 13.1%; 50,000 per cc., 12.8%; 100,000 per cc., 9.1%; 200,000 per cc., 43%.

TABULATION B

INDIVIDUAL DEVIATIONS OF COUNTS OF PASTEURIZED MILK ON STANDARD AGAR AT 32° C.

| *Range* | *Total* | *Increased* | *Per cent* | *Decreased* | *Per cent* | *Identical* | *Per cent* |
|---|---|---|---|---|---|---|---|
| Under 5,000 | 35 | 35 | 100.0 | 0 | 0.0 | 0 | 0.0 |
| 5,100– 10,000 | 52 | 44 | 84.6 | 6 | 11.5 | 2 | 3.9 |
| 11,000– 25,000 | 23 | 21 | 91.4 | 1 | 4.3 | 1 | 4.3 |
| 26,000– 50,000 | 23 | 19 | 82.7 | 3 | 13.0 | 1 | 4.3 |
| 51,000–100,000 | 20 | 18 | 90.0 | 2 | 10.0 | 0 | 0.0 |
| 110,000–200,000 | 11 | 8 | 72.7 | 3 | 27.3 | 0 | 0.0 |
| 210,000–500,000 | 2 | 1 | 50.0 | 1 | 50.0 | 0 | 0.0 |
| Totals | 166 | 146 | 88.0 | 16 | 9.6 | 4 | 2.4 |

ordinate corresponding to its magnitude. This is the "norm" so termed by Kelly,[16] and is the base from which the deviation of the count on the same sample, under the specific conditions studied, is measured.

Caution must be exercised to avoid an erroneous impression of the grouping of the points representing percentages of deviation on these charts. If the whole chart were in each case constructed on the scale applying to the range 1,000 to 10,000, it would be over 16 feet long, and the points above 10,000 would be proportionately more widely scattered.

Wherever coincidence of results was encountered it is indicated by the insertion of numbers applying to this point on the chart.

*Standard Agar at 32°C.*—Chart 1 presents the extent of the deviation of individual counts of pasteurized milk on standard agar at 32°C., from the counts of the same samples on standard agar at 37°C. One hundred and sixty-six counts are located. The deviations range from minus 56 per cent to plus 1,260 per cent. The deviations are tabulated by ranges of magnitudes, as shown in Tabulation B.

The average deviation of all of the 166 counts at 32°C. from those at 37°C.—not the average of the percentage deviations—was 64.3 per cent upward. The average deviation in each range of magnitude, and by laboratories, is given in the recapitulations of Table I.

*T-G-E-M Agar at 37°C.*—Chart 2 presents the extent of the deviation of individual counts of pasteurized milk on T-G-E-M agar, at 37°C., from the counts on the same samples on standard agar, at 37°C. One hundred and ninety-three counts are located. The deviations range from minus 49 per cent to plus 1,600 per cent. (This deviation on a count of 4,000 on standard agar at 37°C., and also one of

TABULATION C

INDIVIDUAL DEVIATIONS OF COUNTS OF PASTEURIZED MILK ON T-G-E-M AGAR AT 37° C.

| *Range* | *Total* | *Increased* | *Per cent* | *Decreased* | *Per cent* | *Identical* | *Per cent* |
|---|---|---|---|---|---|---|---|
| Under 5,000 | 49 | 46 | 93.9 | 3 | 6.1 | 0 | 0.0 |
| 5,100– 10,000 | 58 | 48 | 82.8 | 10 | 17.2 | 0 | 0.0 |
| 11,000– 25,000 | 24 | 18 | 75.0 | 2 | 8.3 | 4 | 16.7 |
| 26,000– 50,000 | 27 | 22 | 81.5 | 5 | 18.5 | 0 | 0.0 |
| 51,000–100,000 | 21 | 17 | 81.0 | 4 | 19.0 | 0 | 0.0 |
| 110,000–200,000 | 11 | 6 | 55.5 | 4 | 36.4 | 1 | 9.1 |
| 210,000–500,000 | 3 | 2 | 66.7 | 1 | 33.3 | 0 | 0.0 |
| Totals | 193 | 159 | 82.4 | 29 | 15.0 | 5 | 2.6 |

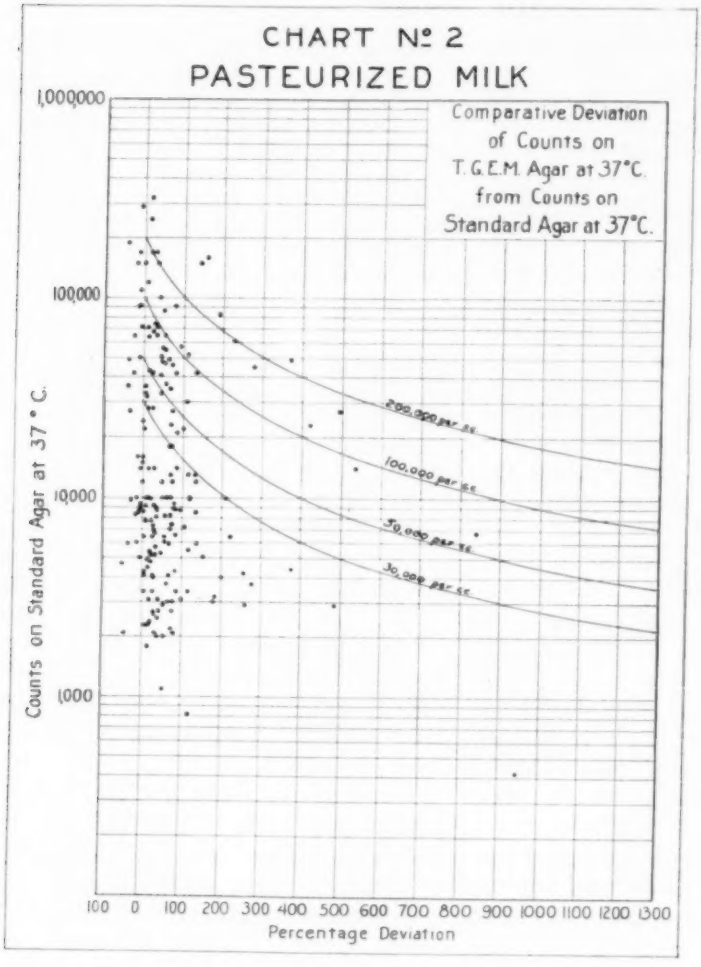


CHART Nº 2
PASTEURIZED MILK
Comparative Deviation of Counts on T.G.E.M. Agar at 37°C. from Counts on Standard Agar at 37°C.
1,000,000
100,000
10,000
1,000
Counts on Standard Agar at 37° C.
200,000 per cc
100,000 per cc
50,000 per cc
30,000 per cc
100 0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300
Percentage Deviation

CHART No. 2—Deviation of counts on T-G-E-M Agar, at 37° C., from those on Standard Agar, at 37° C. 193 Counts. Average deviation: +48.0%.

*Cumulative Deviations:* Counts under 5,000 per cc., +127.0%; under 10,000 per cc., 93.9%; under 25,000 per cc., +92.2%; under 50,000 per cc., +81.7%; under 100,000 per cc., +67.8%; under 200,000 per cc., +54.7%; under 500,000 per cc., +48.0%.

*Counts Exceeding Limit Because of Increase:* 30,000 per cc., 10.2%; 50,000 per cc., 11.4%; 100,000 per cc., 6.7%; 200,000 per cc., 3.2%.

1,329 per cent on a count of 7,700 are not shown in this chart.) The numbers of deviations are tabulated, by ranges of magnitudes, as shown in Tabulation C.

The average deviation of all the 193 counts on T-G-E-M agar at 37°C. was 48.0 per cent upward. The average deviation in each range of magnitude and by laboratories, is given in the recapitulations of Table I.

The greater concentration or lesser dispersion, of points between the norm and plus 50 per cent deviation is to be noted on this chart when compared with Chart 1.

*T-G-E-M Agar at 32°C.*—Chart 3 presents the extent of deviation of individual counts of pasteurized milk on T-G-E-M agar, at 32°C. from the counts on the same samples on standard agar at 37°C. One hundred and sixty-six counts are located. The deviations range from minus 36.8 per cent to plus 1,110 per cent. The numbers and directions of deviations, by ranges of magnitudes, are tabulated as shown in Tabulation D.

The average deviation of all the 166 counts on T-G-E-M agar at 32°C. from those on standard agar, at 37°C., was 113.7 per cent upward. The average

TABULATION D

INDIVIDUAL DEVIATIONS OF COUNTS OF PASTEURIZED MILK ON T-G-E-M AGAR AT 32° C.

| *Range* | *Total* | *Increased* | *Per cent* | *Decreased* | *Per cent* | *Identical* | *Per cent* |
|---|---|---|---|---|---|---|---|
| Under 5,000 | 36 | 36 | 100.0 | 0 | 0.0 | 0 | 0.0 |
| 5,100– 10,000 | 50 | 50 | 100.0 | 0 | 0.0 | 0 | 0.0 |
| 11,000– 25,000 | 24 | 24 | 100.0 | 0 | 0.0 | 0 | 0.0 |
| 26,000– 50,000 | 25 | 24 | 96.0 | 1 | 4.0 | 0 | 0.0 |
| 51,000–100,000 | 18 | 18 | 100.0 | 0 | 0.0 | 0 | 0.0 |
| 110,000–200,000 | 11 | 7 | 63.6 | 4 | 36.4 | 0 | 0.0 |
| 210,000–500,000 | 2 | 1 | 50.0 | 1 | 50.0 | 0 | 0.0 |
| Totals | 166 | 160 | 96.4 | 6 | 3.6 | 0 | 0.0 |

deviation, in each range of magnitude, and by laboratories, is given in the recapitulations of Table I.

The very general increase in count by the use of T-G-E-M agar and incubation at 32°C., is made strikingly evident by a comparison of Chart 3, with Charts 1 and 2. The scatter to

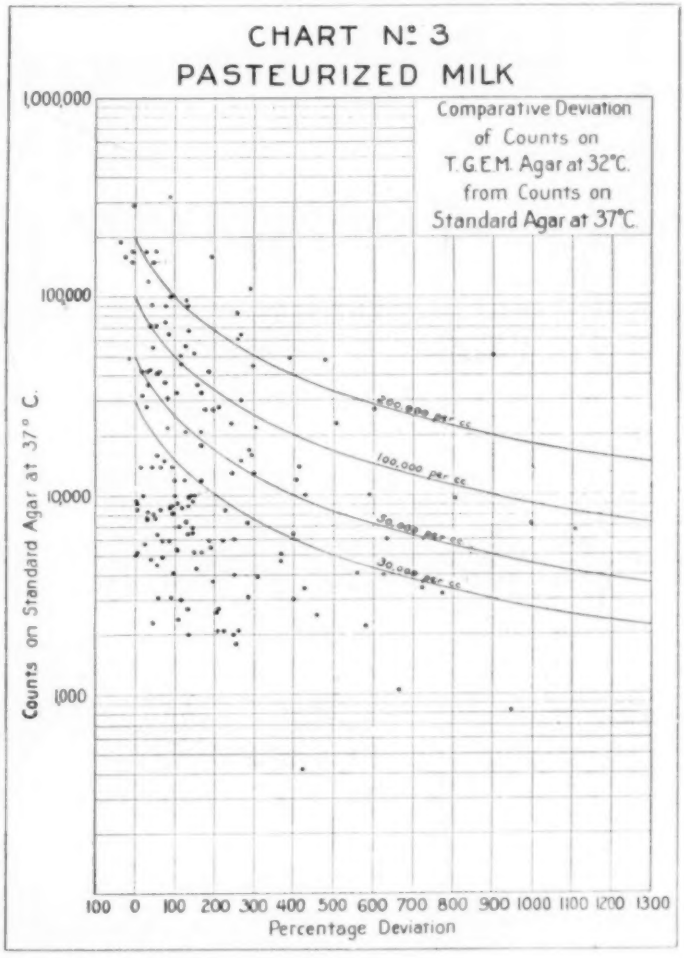


CHART Nº 3
PASTEURIZED MILK
Comparative Deviation of Counts on T.G.E.M. Agar at 32°C. from Counts on Standard Agar at 37°C.
1,000,000
100,000
10,000
1000
Counts on Standard Agar at 37° C.
500,000 per cc
100,000 per cc
50,000 per cc
30,000 per cc
100 0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300
Percentage Deviation

CHART NO. 3—Deviation of counts on T-G-E-M Agar, at 32° C., from those on Standard Agar, at 37° C. 166 Counts. Average deviation: +133.7%.

*Cumulative Deviations:* Counts under 5,000 per cc., +267.8%; under 10,000 per cc., +205.3%; under 25,000 per cc., +201.5%; under 50,000 per cc., +196.4%; under 100,000 per cc., +162.6%; under 200,000 per cc., +122.4%; under 500,000 per cc., +133.7%.

*Counts Exceeding Limit Because of Increase:* 30,000 per cc., 24.1%; 50,000 per cc., 25.9%; 100,000 per cc., 15.0%; 200,000 per cc., 8.5%.

TABLE I

*Analysis of Plate Counts of Pasteurized Milk Made on Three Agars, at Two Incubation Temperatures, By Magnitudes of Counts on Standard Agar at 37° C., and by Laboratories*

| | Agars and Incubation Temperatures | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Standard Agar at 37° C.* | | *Standard Agar at 32° C.* | | | *T-G-E-M Agar at 37° C.* | | | *T-G-E-M Agar at 32° C.* | | | *A.A.M.M.C. Agar at 37° C.* | | | *A.A.M.M.C. Agar at 32° C.* | | |
| *Laboratory* | *No.* | *Avg. Count* | *No.* | *Avg. Count* | *% Dev.* | *No.* | *Avg. Count* | *% Dev.* | *No.* | *Avg. Count* | *% Dev.* | *No.* | *Avg. Count* | *% Dev.* | *No.* | *Avg. Count* | *% Dev.* |
| | | | | | | | *Counts of 5,000 or Less* | | | | | | | | | | |
| A | .. | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... |
| B | 5 | 2,820 | 5 | 8,760 | 210.5 | 5 | 5,220 | 85.2 | 5 | 13,640 | 384.0 | 4 | 5,725 | 109.0 | 5 | 10,920 | 322.5 |
| C | 12 | 3,808 | 10 | 5,560 | 46.7 | 12 | 5,425 | 50.3 | 11 | 7,327 | 100.0 | 12 | 5,517 | 52.8 | 12 | 7,117 | 97.2 |
| D | 8 | 2,305 | 8 | 10,588 | 359.0 | 8 | 2,800 | 21.5 | 8 | 12,388 | 437.4 | 8 | 2,226 | 3.4 | 7 | 10,743 | 447.0 |
| E | 12 | 3,025 | 12 | 8,150 | 169.5 | 12 | 5,233 | 73.0 | 12 | 9,792 | 224.0 | 12 | 3,075 | 1.6 | 12 | 8,267 | 173.0 |
| F | 12 | 3,525 | .. | .... | .... | 12 | 14,508 | 310.0 | .. | .... | .... | 10 | 10,090 | 184.0 | .. | .... | .... |
| Total | 49 | 3,152 | 35 | 8,054 | 164.0 | 49 | 7,153 | 127.0 | 36 | 11,068 | 267.8 | 46 | 5,320 | 69.1 | 36 | 8,733 | 193.0 |
| | | | | | | | *Counts from 5,100 to 10,000 Inclusive* | | | | | | | | | | |
| A | 1 | 6,700 | 1 | 23,000 | 244.0 | 1 | 63,000 | 840.0 | 1 | 81,000 | 1,110.0 | 1 | 13,000 | 94.0 | 1 | 28,000 | 318.0 |
| B | 7 | 8,114 | 7 | 25,571 | 215.0 | 7 | 10,757 | 32.6 | 6 | 26,250 | 224.0 | 6 | 9,633 | 20.2 | 6 | 42,000 | 423.0 |
| C | 19 | 7,889 | 19 | 11,363 | 44.0 | 19 | 8,690 | 10.1 | 18 | 13,780 | 85.6 | 18 | 8,516 | 14.8 | 8 | 12,384 | 64.0 |
| D | 5 | 5,820 | 5 | 9,160 | 57.4 | 5 | 7,920 | 36.0 | 5 | 11,880 | 104.0 | 5 | 6,680 | 14.8 | 5 | 8,800 | 51.2 |
| E | 20 | 7,805 | 20 | 14,440 | 84.9 | 20 | 15,340 | 96.4 | 20 | 28,650 | 267.0 | 20 | 11,095 | 42.1 | 20 | 19,295 | 147.0 |
| F | 6 | 8,117 | .. | .... | .... | 6 | 27,833 | 243.0 | .. | .... | .... | 6 | 21,383 | 163.5 | .. | .... | .... |
| Total | | 7,712 | 52 | 14,472 | 88.7 | 58 | 14,082 | 80.3 | 50 | 22,654 | 197.0 | 56 | 11,004 | 43.4 | 50 | 18,904 | 146.4 |
| | | | | | | | *Counts from 11,000 to 25,000 Inclusive* | | | | | | | | | | |
| A | 2 | 18,000 | 3 | 45,333 | 156.5 | 2 | 66,500 | 270.0 | 3 | 75,667 | 328.0 | 3 | 36,000 | 104.0 | 3 | 70,000 | 269.2 |
| B | 8 | 16,250 | 10 | 30,800 | 85.5 | 8 | 19,875 | 22.3 | 10 | 41,900 | 152.0 | 10 | 16,890 | 1.7 | 9 | 39,444 | 135.1 |
| C | 4 | 16,000 | 3 | 15,000 | 15.4 | 4 | 26,000 | 62.5 | 4 | 33,250 | 92.2 | 4 | 20,500 | 28.1 | 4 | 28,000 | 75.0 |
| D | 3 | 13,000 | 3 | 27,000 | 108.0 | 3 | 22,667 | 74.3 | 3 | 34,333 | 180.5 | 3 | 20,167 | 55.0 | 3 | 24,333 | 87.0 |
| E | 4 | 19,000 | 4 | 27,250 | 43.4 | 4 | 54,500 | 187.0 | 4 | 74,750 | 293.0 | 4 | 22,500 | 18.4 | 4 | 34,250 | 80.3 |
| F | 3 | 18,333 | .. | .... | .... | 3 | 25,333 | 38.2 | .. | .... | .... | 2 | 17,500 | —5.4 | .. | .... | .... |
| Total | 24 | 16,667 | 23 | 29,522 | 82.0 | 24 | 31,583 | 89.5 | 24 | 49,208 | 196.7 | 26 | 20,938 | 25.1 | 23 | 38,565 | 131.6 |
| | | | | | | | *Counts from 26,000 to 50,000 Inclusive* | | | | | | | | | | |
| A | 6 | 38,333 | 4 | 107,250 | 158.0 | 6 | 105,500 | 175.0 | 6 | 156,333 | 308.0 | 6 | 122,000 | 218.0 | 4 | 125,750 | 220.0 |
| B | 5 | 38,000 | 6 | 54,667 | 48.3 | 5 | 48,200 | 26.9 | 6 | 75,333 | 104.5 | 5 | 52,800 | 38.9 | 5 | 61,440 | 71.4 |
| C | 8 | 36,375 | 8 | 52,750 | 45.0 | 8 | 40,125 | 10.3 | 8 | 59,500 | 63.5 | 8 | 40,125 | 10.3 | 8 | 55,875 | 53.6 |
| D | 2 | 43,500 | 2 | 47,500 | 9.2 | 2 | 123,500 | 184.0 | 2 | 117,500 | 170.0 | 2 | 124,000 | 185.0 | 2 | 134,000 | 208.0 |
| E | 3 | 38,333 | 3 | 269,333 | 611.0 | 3 | 46,000 | 20.0 | 3 | 217,333 | 467.0 | 3 | 49,333 | 28.7 | 3 | 297,000 | 675.0 |
| F | 3 | 37,000 | .. | .... | .... | 3 | 70,333 | 61.0 | .. | .... | .... | 2 | 47,000 | 14.6 | .. | .... | .... |
| Total | 27 | 38,667 | 23 | 90,522 | 135.5 | 27 | 66,333 | 71.6 | 25 | 110,120 | 191.6 | 26 | 69,500 | 81.6 | 22 | 109,818 | 191.4 |

TABLE I (Cont.)

TABLE I (Cont.)

*Agars and Incubation Temperatures*

| Laboratory | Standard Agar at 37° C. No. | Standard Agar at 37° C. Avg. Count | Standard Agar at 32° C. No. | Standard Agar at 32° C. Avg. Count | Standard Agar at 32° C. % Dev. | T-G-E-M Agar at 37° C. No. | T-G-E-M Agar at 37° C. Avg. Count | T-G-E-M Agar at 37° C. % Dev. | T-G-E-M Agar at 32° C. No. | T-G-E-M Agar at 32° C. Avg. Count | T-G-E-M Agar at 32° C. % Dev. | A.A.M.M.C. Agar at 37° C. No. | A.A.M.M.C. Agar at 37° C. Avg. Count | A.A.M.M.C. Agar at 37° C. % Dev. | A.A.M.M.C. Agar at 32° C. No. | A.A.M.M.C. Agar at 32° C. Avg. Count | A.A.M.M.C. Agar at 32° C. % Dev. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Counts from 51,000 to 100,000 Inclusive* | | | | | | | | | | | | | | | | | |
| A | 2 | 69,000 | 2 | 109,500 | 58.7 | 2 | 101,500 | 47.1 | 2 | 155,000 | 125.0 | 2 | 83,500 | 21.0 | 2 | 129,500 | 87.0 |
| B | 8 | 65,625 | 9 | 143,889 | 111.0 | 8 | 90,000 | 37.1 | 7 | 138,571 | 110.0 | 8 | 74,625 | 8.7 | 8 | 119,375 | 73.5 |
| C | 6 | 76,333 | 6 | 124,833 | 63.4 | 6 | 113,000 | 48.0 | 6 | 155,000 | 103.0 | 6 | 117,667 | 54.1 | 6 | 166,667 | 118.3 |
| D | .. | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... |
| E | 3 | 82,667 | 3 | 109,333 | 32.3 | 3 | 160,000 | 93.5 | 3 | 200,000 | 142.0 | 3 | 136,667 | 65.3 | 3 | 190,000 | 130.0 |
| F | 2 | 60,000 | .. | .... | .... | 2 | 68,000 | 13.3 | .. | .... | .... | 2 | 41,000 | —31.7 | .. | .... | .... |
| Total | 21 | 70,905 | 20 | 129,550 | 77.7 | 21 | 104,620 | 47.5 | 18 | 156,111 | 115.3 | 21 | 93,429 | 29.7 | 19 | 141,263 | 99.7 |
| *Counts from 110,000 to 200,000 Inclusive* | | | | | | | | | | | | | | | | | |
| A | .. | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... |
| B | 3 | 126,667 | 4 | 192,500 | 23.0 | 3 | 116,667 | —7.9 | 4 | 212,500 | 57.4 | 4 | 146,000 | 8.1 | 4 | 160,000 | 18.5 |
| C | 6 | 158,333 | 6 | 175,000 | 4.0 | 6 | 215,000 | 27.7 | 6 | 241,667 | 43.5 | 6 | 220,000 | 30.7 | 6 | 236,667 | 40.6 |
| D | 1 | 150,000 | 1 | 160,000 | 6.7 | 1 | 150,000 | 0.0 | 1 | 220,000 | 46.7 | 1 | 160,000 | 6.7 | 1 | 270,000 | 80.0 |
| E | .. | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... |
| F | 1 | 150,000 | .. | .... | .... | 1 | 360,000 | 140.0 | .. | .... | .... | 1 | 320,000 | 113.3 | .. | .... | .... |
| Total | 11 | 153,627 | 11 | 180,000 | 16.5 | 11 | 195,454 | 27.2 | 11 | 229,091 | 48.2 | 12 | 216,727 | 28.9 | 11 | 211,818 | 37.0 |
| *Counts from 210,000 to 500,000 Inclusive* | | | | | | | | | | | | | | | | | |
| A | .. | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... |
| B | 1 | 250,000 | .. | .... | .... | 1 | 280,000 | 12.0 | .. | .... | .... | .. | .... | .... | .. | .... | .... |
| C | 1 | 290,000 | 1 | 270,000 | —6.9 | 1 | 260,000 | —10.3 | 1 | 280,000 | —3.4 | 1 | 280,000 | —3.4 | 1 | 300,000 | 3.4 |
| D | .. | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... |
| E | 1 | 320,000 | 1 | 450,000 | 40.6 | 1 | 380,000 | 18.7 | 1 | 600,000 | 87.5 | 1 | 280,000 | —12.5 | 1 | 340,000 | 6.7 |
| F | .. | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... | .. | .... | .... |
| Total | 3 | 286,667 | 2 | 360,000 | 18.0 | 3 | 306,667 | 7.0 | 2 | 440,000 | 27.5 | 2 | 280,000 | —8.2 | 2 | 320,000 | 4.9 |
| *Recapitulation, According to Count Magnitudes* | | | | | | | | | | | | | | | | | |
| Under 5,000 | 49 | 3,152 | 35 | 8,054 | 164.0 | 49 | 7,153 | 127.0 | 36 | 11,068 | 267.8 | 46 | 5,320 | 69.1 | 36 | 8,733 | 193.0 |
| 5,100–10,000 | 58 | 7,712 | 52 | 14,472 | 88.7 | 58 | 14,082 | 80.3 | 50 | 22,654 | 197.0 | 56 | 11,004 | 43.4 | 50 | 18,904 | 146.4 |
| 11,000–25,000 | 24 | 16,667 | 23 | 29,522 | 82.0 | 24 | 31,583 | 89.5 | 24 | 49,208 | 196.7 | 26 | 20,938 | 25.1 | 23 | 38,565 | 131.6 |
| 26,000–50,000 | 27 | 38,667 | 23 | 90,522 | 135.5 | 27 | 66,333 | 71.6 | 25 | 110,120 | 191.6 | 26 | 69,500 | 81.6 | 22 | 109,818 | 191.4 |
| 51,000–100,000 | 21 | 70,905 | 20 | 129,550 | 77.7 | 21 | 104,620 | 47.5 | 18 | 156,111 | 115.3 | 21 | 93,429 | 29.7 | 19 | 141,263 | 99.7 |
| 110,000–200,000 | 11 | 153,627 | 11 | 180,000 | 16.5 | 11 | 195,454 | 27.2 | 11 | 229,091 | 48.2 | 12 | 216,727 | 28.9 | 11 | 211,818 | 37.0 |
| 210,000–500,000 | 3 | 286,667 | 2 | 360,000 | 18.0 | 3 | 306,667 | 7.0 | 2 | 440,000 | 27.5 | 2 | 280,000 | —8.2 | 2 | 320,000 | 4.9 |
| Total | 193 | 31,527 | 166 | 54,737 | 64.3 | 193 | 46,649 | 48.0 | 166 | 70,133 | 113.7 | 189 | 42,954 | 35.8 | 163 | 63,292 | 90.8 |

Continued—page 832

TABLE I (Cont.)

| Laboratory | Standard Agar at 37° C. | | Standard Agar at 32° C. | | | T-G-E-M Agar at 37° C. | | | T-G-E-M Agar at 32° C. | | | A.A.M.M.C. Agar at 37° C. | | | A.A.M.M.C. Agar at 32° C. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Avg. Count | No. | Avg. Count | % Dev. | No. | Avg. Count | % Dev. | No. | Avg. Count | % Dev. | No. | Avg. Count | % Dev. | No. | Avg. Count | % Dev. |
| *Recapitulation, By Laboratories* | | | | | | | | | | | | | | | | | |
| A | 11 | 37,336 | 10 | 80,700 | 119.5 | 11 | 93,818 | 151.3 | 12 | 129,667 | 263.8 | 12 | 85,000 | 138.5 | 10 | 100,000 | 181.9 |
| B | 37 | 41,781 | 41 | 71,312 | 81.4 | 37 | 50,038 | 19.8 | 38 | 76,755 | 101.1 | 37 | 45,800 | 12.7 | 37 | 69,286 | 73.0 |
| C | 56 | 41,182 | 53 | 52,972 | 23.4 | 56 | 51,486 | 25.0 | 54 | 66,878 | 57.4 | 55 | 53,400 | 27.8 | 55 | 65,449 | 56.5 |
| D | 19 | 17,028 | 19 | 24,553 | 44.2 | 19 | 27,737 | 62.9 | 19 | 37,711 | 121.4 | 19 | 27,353 | 60.6 | 18 | 38,432 | 129.0 |
| E | 43 | 22,126 | 43 | 48,409 | 118.8 | 43 | 36,874 | 66.7 | 43 | 66,081 | 198.7 | 43 | 27,600 | 24.7 | 43 | 56,351 | 145.7 |
| F | 27 | 20,259 | .. | .... | .... | 27 | 41,633 | 105.5 | .. | .... | .... | 23 | 33,052 | 60.6 | .. | .... | .... |
| Total | 193 | 33,315 | 166 | 54,737 | 64.3 | 193 | 46,649 | 48.0 | 166 | 70,133 | 113.7 | 189 | 42,954 | 35.8 | 163 | 63,292 | 90.8 |

TABLE II

*Analysis of Plate Counts of Raw Milk Made on Three Agars, at Two Incubation Temperatures, By Magnitudes of Counts on Standard Agar, at 37° C.*

| | Standard Agar at 37° C. | | Standard Agar at 32° C. | | | T-G-E-M Agar at 37° C. | | | T-G-E-M Agar at 32° C. | | | A.A.M.M.C. Agar at 37° C. | | | A.A.M.M.C. Agar at 32° C. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Avg. Count | No. | Avg. Count | % Dev. | No. | Avg. Count | % Dev. | No. | Avg. Count | % Dev. | No. | Avg. Count | % Dev. | No. | Avg. Count | % Dev. |
| Under 5,000 | 9 | 3,300 | 6 | 6,450 | +87.0 | 9 | 3,422 | + 3.7 | 6 | 6,483 | +88.0 | 9 | 3,900 | +18.3 | 6 | 6,933 | +101.0 |
| 5,100–10,000 | 5 | 7,620 | 2 | 13,000 | + 5.3 | 5 | 8,920 | +17.1 | 1 | 13,000 | +83.0 | 5 | 8,620 | +13.1 | 2 | 11,500 | + 3.5 |
| 11,000–25,000 | 2 | 12,500 | 2 | 22,000 | +76.0 | 2 | 15,000 | +20.0 | 2 | 39,000 | +21.2 | 2 | 9,750 | —22.0 | 2 | 15,000 | + 20.0 |
| 26,000–50,000 | 2 | 35,500 | 2 | 71,000 | +56.0 | 2 | 42,000 | +18.3 | 2 | 89,500 | +96.6 | 2 | 53,000 | +44.5 | 2 | 105,000 | +131.0 |
| 51,000–100,000 | 5 | 85,200 | 5 | 119,200 | +39.8 | 5 | 105,400 | +23.7 | 5 | 166,000 | +94.7 | 5 | 132,000 | +54.9 | 5 | 152,000 | + 78.4 |
| 110,000–200,000 | 6 | 148,333 | 6 | 177,500 | +17.7 | 6 | 159,833 | + 7.7 | 5 | 200,400 | +45.7 | 6 | 190,000 | +28.1 | 5 | 200,000 | + 42.8 |
| 210,000–500,000 | 3 | 250,000 | 3 | 306,667 | +22.6 | 3 | 263,333 | + 5.3 | 2 | 330,000 | +22.2 | 3 | 273,333 | + 9.4 | 2 | 255,000 | — 5.6 |
| Over 1,000,000 | 1 | 2,100,000 | 1 | 2,300,000 | + 9.5 | 1 | 2,800,000 | +33.3 | .. | .... | .... | 1 | 2,800,000 | +33.3 | 1 | 3,000,000 | + 42.8 |
| Total | 33 | 131,206 | 27 | 190,063 | +16.1 | 33 | 159,558 | +21.6 | 23 | 121,778 | +54.8 | 34 | 166,962 | +24.2 | 25 | 222,984 | + 15.2 |

the right of the norm—percentage increase—is much more pronounced in Chart 3 than in Chart 1, and in only 6 cases was the deviation negative, representing a decreased count. The only variable in Charts 1 and 3 being the medium employed, it is obvious that T-G-E-M agar yields generally higher counts than standard agar. Chart 3 therefore corroborates Chart 2.

*A.A.M.M.C. Agar at 37°C.*—Chart 4 presents the extent of the deviation of individual counts of pasteurized milk on A.A.M.M.C. agar at 37°C., from counts of the same samples on standard agar at 37°C. One hundred and eighty-nine counts are located. The deviations range from minus 76.0 per cent (a decrease from 65,000 on standard agar at 37°C. to 16,000 on A.A.M.M.C. agar) to plus 991 per cent. The deviations, by ranges of magnitudes and direction, are shown in Tabulation E. The average deviation of all the 189 counts on A.A.M.M.C. agar at 37°C. from those on standard agar at 37°C. was 35.8 per cent upward. The average deviation in each range of magnitude and by laboratories is given in the recapitulations of Table I.

Comparison of Charts 2 and 4 emphasizes the greater concentration

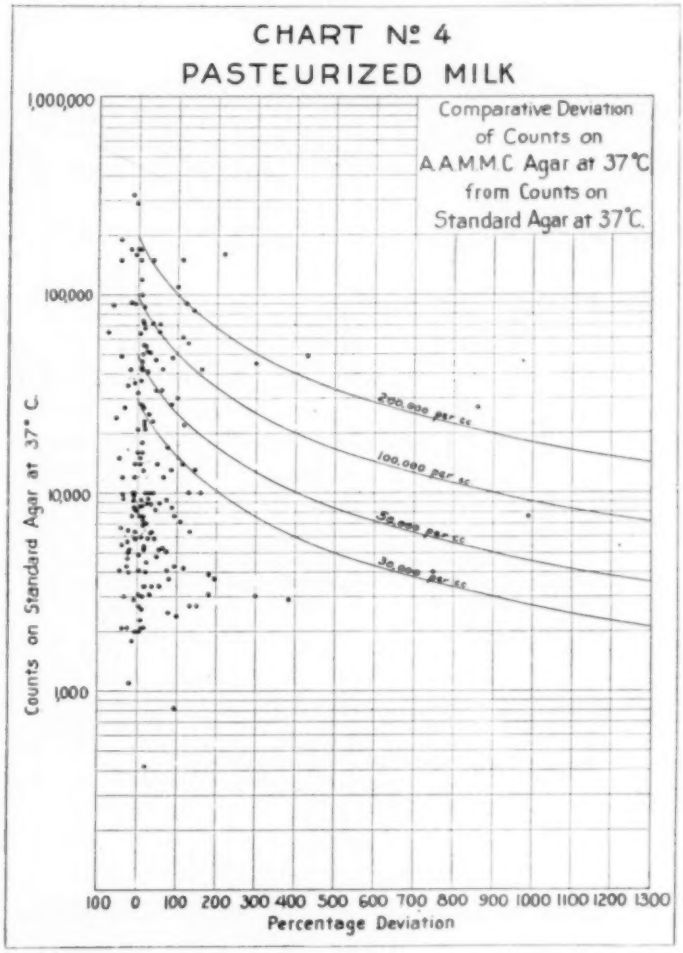


CHART Nº 4
PASTEURIZED MILK
Comparative Deviation of Counts on A.A.M.M.C Agar at 37°C from Counts on Standard Agar at 37°C.
1,000,000
100,000
10,000
1,000
Counts on Standard Agar at 37° C.
200,000 per cc
100,000 per cc
50,000 per cc
30,000 per cc
100 0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300
Percentage Deviation

CHART No. 4—Deviation of Counts on A.A.M.M.C Agar, at 37° C., from those on Standard Agar, at 37° C. 189 Counts. Average deviation: +35.8%.

*Cumulative Deviations:* Counts under 5,000 per cc., +69.1%; under 10,000 per cc., +49.9%; under 25,000 per cc., +39.2%; under 50,000 per cc., +60.3%; under 100,000 per cc., +47.1%; under 200,000 per cc., +40.8%; under 500,000 per cc., +35.8%.

*Counts Exceeding Limit Because of Increase:* 30,000 per cc., 7.4%; 50,000 per cc., 9.1+; 100,000 per cc., 5.7%; 200,000 per cc., 3.2%.

TABULATION E

INDIVIDUAL DEVIATIONS OF COUNTS OF PASTEURIZED MILK ON A.A.M.M.C. AGAR AT 37° C.

| *Range* | *Total* | *Increased* | *Per cent* | *Decreased* | *Per cent* | *Identical* | *Per cent* |
|---|---|---|---|---|---|---|---|
| Under 5,000 | 46 | 33 | 71.8 | 13 | 28.2 | 0 | 0.0 |
| 5,100– 10,000 | 56 | 38 | 67.9 | 17 | 30.3 | 1 | 1.8 |
| 11,000– 23,000 | 26 | 18 | 69.2 | 6 | 23.1 | 2 | 7.7 |
| 26,000– 50,000 | 26 | 19 | 73.1 | 6 | 23.1 | 1 | 3.8 |
| 51,000–100,000 | 21 | 17 | 80.9 | 4 | 19.1 | 0 | 0.0 |
| 110,000–200,000 | 12 | 7 | 58.4 | 4 | 33.3 | 1 | 8.3 |
| 210,000–500,000 | 2 | 0 | 0.0 | 2 | 100.0 | 0 | 0.0 |
| Total | 189 | 132 | 69.8 | 52 | 27.6 | 5 | 2.6 |

of deviation points along the "norm" in Chart 4. The foregoing tabulation points to this result in that increase in the count occurred on A.A.M.M.C. agar in only 69.8 per cent of the cases, as compared with increases in 82.4 per cent of the counts on T-G-E-M agar at 37°C.

*A.A.M.M.C. Agar at 32°C.*—Chart 5 presents the extent of the deviation of

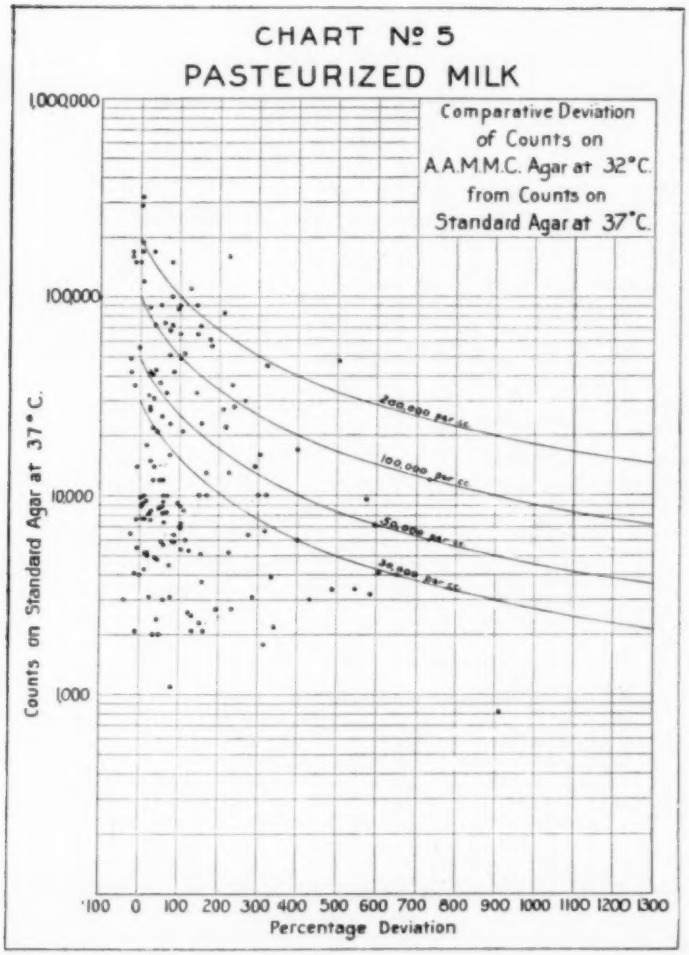


CHART Nº 5
PASTEURIZED MILK
Comparative Deviation of Counts on A.A.M.M.C. Agar at 32°C. from Counts on Standard Agar at 37°C.
1,000,000
100,000
10,000
1,000
Counts on Standard Agar at 37° C.
-100 0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300
Percentage Deviation

CHART NO. 5—Deviation of counts on A.A.M.M.C. Agar, at 32° C., from those on Standard Agar, at 37° C. 163 Counts. Average deviation: +90.8%.

*Cumulative Deviations:* Counts under 5,000 per cc., +193.0%; under 10,000 per cc., +156.5%; under 25,000 per cc., +145.6%; under 50,000 per cc., +167.9%; under 100,000 per cc., +137.2%; under 200,000 per cc., +101.4%; under 500,000 per cc., +90.8%.

*Counts Exceeding Limit Because of Increase:* 30,000 per cc., 18.2%; 50,000 per cc., 16.8%; 100,000 per cc., 14.0%; 200,000 per cc., 4.3%.

TABULATION F

INDIVIDUAL DEVIATIONS OF COUNTS OF PASTEURIZED MILK ON A.A.M.M.C. AGAR AT 32° C.

| *Range* | *Total* | *Increased* | *Per cent* | *Decreased* | *Per cent* | *Identical* | *Per cent* |
|---|---|---|---|---|---|---|---|
| Under 5,000 | 36 | 32 | 88.9 | 3 | 8.3 | 1 | 2.8 |
| 5,100– 10,000 | 50 | 46 | 92.0 | 4 | 8.0 | 0 | 0.0 |
| 11,000– 25,000 | 23 | 22 | 95.7 | 1 | 4.3 | 0 | 0.0 |
| 26,000– 50,000 | 22 | 19 | 86.4 | 3 | 13.6 | 0 | 0.0 |
| 51,000–100,000 | 19 | 18 | 94.7 | 1 | 5.3 | 0 | 0.0 |
| 110,000–200,000 | 11 | 7 | 63.6 | 3 | 27.3 | 1 | 9.1 |
| 210,000–500,000 | 2 | 2 | 100.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 163 | 146 | 89.6 | 15 | 9.2 | 2 | 1.2 |

individual counts of pasteurized milk on A.A.M.M.C. agar, at 32°C., from the counts of the same samples on standard agar at 37°C. One hundred and sixty-three counts are located. The deviations range from minus 40 per cent to plus 1,750 per cent (on a count of 8,200 on standard agar at 37°C., an increase to 150,000 on A.A.M.M.C. agar at 32°C.—not shown on this

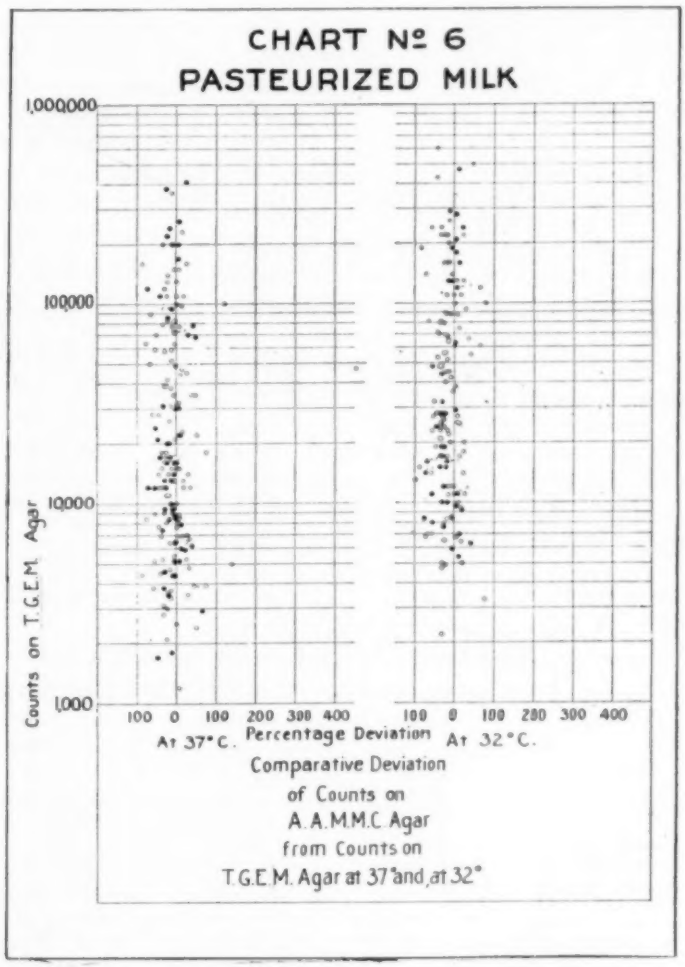



CHART No. 6—Comparative Deviation of Counts on A.A.M.M.C. Agar from counts on T-G-E-M Agar, at 37° C., and at 32° C.

The percentages of deviation of the screened counts are indicated by the solid spots.

chart). The deviations are tabulated by ranges of magnitudes and direction as shown in Tabulation F.

The average deviation of all the 163 counts on A.A.M.M.C. agar at 32°C. from those on standard agar at 37°C. was 90.8 per cent upward. The average deviation in each range of magnitude and by laboratories, is given in the recapitulation of Table I. When compared with Charts 1 and 3, it is to be noted that the dispersion of points on Chart 5 is greater than that on Chart 1, but less than that on Chart 3.

The data from which Charts 1 to 5 were made are summarized in Table I.

Caution is advised in considering the average total counts and percentages of average deviation of the counts on the several media at the two temperatures for a slight deviation in one direction on a very high count may balance and nullify considerable deviation in the opposite direction on a number of lower counts. For this reason, the percentages of deviation of the average counts in the several ranges of count magnitude on standard agar at 37°C. are probably more significant than are the totals.

### COMPARISON OF COUNTS ON T-G-E-M AND ON A.A.M.M.C. AGARS, AT 37°C. AND AT 32°C.

Since the primary purpose of the committee in conducting this study was to obtain data upon which to predicate a decision concerning an improvement in culture medium and a change in temperature of incubation, a more direct comparison of the two media under consideration than is possible by means of individual comparisons of each with standard agar appeared desirable. Such comparisons of counts on these two media at both 37°C. and 32°C., are presented in Chart 6.

In both instances the counts on T-G-E-M agar constituted the bases from which were computed the per-

TABULATION G

COMPARISONS OF T-G-E-M AND A.A.M.M.C. AGARS AT 37° C.

| *Range* | *No. of Counts* | *T-G-E-M Avg. Count* | *A.A.M.M.C. Avg. Count* | *Average Deviation* |
|---|---|---|---|---|
| Under 5,000 | 29 | 3,498 | 3,517 | +0.3 Per cent |
| 5,100– 10,000 | 39 | 7,528 | 6,841 | —9.1 " " |
| 11,000– 25,000 | 44 | 15,841 | 13,445 | —15.1 " " |
| 26,000– 50,000 | 22 | 36,909 | 43,091 | +16.7 " " |
| 51,000–100,000 | 25 | 77,520 | 74,880 | —3.4 " " |
| 110,000–200,000 | 17 | 145,294 | 121,294 | —19.7 " " |
| Over 200,000 | 7 | 300,000 | 288,571 | —3.8 " " |
| Totals | 183 | 45,969 | 42,417 | —6.5 " " |

COMPARISONS OF T-G-E-M AND A.A.M.M.C. AGARS AT 32° C.

| *Range* | *No. of Counts* | *T-G-E-M Avg. Count* | *A.A.M.M.C. Avg. Count* | *Average Deviation* |
|---|---|---|---|---|
| Under 5,000 | 6 | 4,183 | 3,900 | —6.8 Per cent |
| 5,100– 10,000 | 24 | 7,792 | 6,575 | —15.6 " " |
| 11,000– 25,000 | 45 | 17,133 | 13,224 | —22.8 " " |
| 26,000– 50,000 | 22 | 36,136 | 26,591 | —26.6 " " |
| 51,000–100,000 | 27 | 72,851 | 68,778 | —5.6 " " |
| 110,000–200,000 | 20 | 144,500 | 131,700 | —8.8 " " |
| Over 200,000 | 15 | 309,333 | 278,600 | —9.9 " " |
| Totals | 159 | 70,913 | 63,090 | —10.1 " " |

TABULATION H

RELATIONSHIP OF COUNTS ON A.A.M.M.C. AGAR TO COUNTS ON T-G-E-M AGAR

| Incubation Temperature | No. of Counts | Increased | | Decreased | | Identical | |
|---|---|---|---|---|---|---|---|
| | | No. | Per cent | No. | Per cent | No. | Per cent |
| 37° C. | 183 | 56 | 30.6 | 119 | 65.0 | 8 | 4.4 |
| 32° C. | 159 | 47 | 29.6 | 108 | 67.9 | 4 | 3.5 |

centage deviations of the counts of the same samples on A.A.M.M.C. agar.

Comparisons of Chart 2 with 4, and of Chart 3 with 5 indicate that the dispersion of counts from the norm, or the increase in count is greater on T-G-E-M agar than on A.A.M.M.C. agar. The recapitulations of Table I confirm this. It is to be expected, therefore, that when the magnitudes of counts on A.A.M.M.C. agar are compared with those of the same samples on T-G-E-M agar, a negative deviation will be noted.

The average deviation by count magnitudes was by no means uniform, either in percentage or in direction. This is confirmed by Tabulation G.

It is to be noted that, except in two ranges of magnitudes of counts on T-G-E-M agar, at 37°C., the average deviation of the counts on A.A.M.M.C. agar was always negative; that is, the T-G-E-M agar counts were, on the whole, the higher.

In terms of numbers of individual counts, the relationships of A.A.M.M.C. agar counts to those on T-G-E-M agar, at the two temperatures, were as shown in Tabulation H.

It is quite clear, then, that regardless of the manner in which the relationship is determined, counts on T-G-E-M agar were, on the whole, higher than those on A.A.M.M.C. agar.

(The difference in designation of points on Chart 6 is explained in Part II).

## RAW MILK COUNTS ON THE SEVERAL MEDIA, AND AT THE TWO TEMPERATURES OF INCUBATION

The number of reports of results of the platings of raw milk was so small (34 was the maximum number on which comparisons were possible) that a scatter diagram would be rather valueless. However, summaries of the data on this type of sample, similar to those given in one of the recapitulations of Table I, are given in Table II.

A comparison of Table II with the parallel portion of Table I reveals the fact that the average deviations of the counts of raw milk are consistently lower than those of pasteurized milk. In only 5 of the 35 parallel ranges and culture conditions is the average deviation greater in the case of raw milk than in the case of pasteurized milk.

However, no conclusions may be drawn from the average behavior of groups of 6 or less samples, even though they be in the same general magnitude

TABULATION I

COMPARISON OF AVERAGE PERCENTAGE DEVIATIONS

| | Stand. Agar—32° C. | | T-G-E-M Agar—37° C. | | T-G-E-M Agar—32° C. | | A.A.M.M.C. Agar—37° C. | | A.A.M.M.C. Agar—32° C. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Avg. Count | Per cent Dev. | Avg. Count | Per cent Dev. | Avg. Count | Per cent Dev. | Avg. Count | Per cent Dev. | Avg. Count | Per cent Dev. |
| Past. | 54,737 | +64.3 | 46,649 | +48.0 | 70,133 | +113.7 | 42,954 | +35.8 | 63,292 | +90.8 |
| Raw | 190,363 | +16.1 | 159,558 | +21.6 | 121,778 | + 54.8 | 166,962 | +24.2 | 222,984 | +15.2 |

range. The average deviations for the whole groups of pasteurized milk and raw milk counts are somewhat more significant, and bear a rather striking comparison to one another, as Tabulation I shows.

As previous investigators who have examined larger numbers of samples with T-G-E-M agar have reported similar findings, a possible and probable explanation of the lower average percentage of deviation in the case of raw milk is that the bacterial flora of raw milk grows better on the present standard agar than does the flora of pasteurized milk.

### PASTEURIZED CREAM COUNTS ON THE SEVERAL MEDIA AND AT THE TWO TEMPERATURES

Seventeen of the 23 pasteurized cream counts reported were usable, but this number was too small to be segregated into groups, according to magnitudes, from the findings of which conclusions might be drawn. Because, however, of the striking divergence of some of the figures for pasteurized cream from the parallel figures for pasteurized milk (Table I) and raw milk (Table II), summaries and computations applying to the whole set of reports on this product are presented in Tabulation J.

It is worthy of note that the effect of 32°C. incubation was greater than the effect of the use of either of the improved agars. This is in line with previous findings that have indicated the presence of a low temperature flora in pasteurized cream and ice cream mixes whose presence is not indicated in any way when incubation is at 37°C.

### ACTION OF THE COMMITTEE

The foregoing presentation of data constitutes an amplification of the preliminary report[21] placed before the Committee on Standard Methods for the Examination of Dairy and Food Products on October 25, 1938.

Because of the more universal increase of the plate count on T-G-E-M agar than on the A.A.M.M.C. agar, both from the standpoint of frequency and extent of increase, the Tryptone-glucose-extract-skim milk (T-G-E-M) agar was selected as the standard agar. It was recommended that it be put into use, from and after July 1, 1939.[22]

TABULATION J

COMPARISONS OF RAW AND PASTEURIZED MILK AND PASTEURIZED CREAM COUNTS

| | | *Milk Raw* | *Milk Pasteurized* | *Cream Pasteurized* |
|---|---|---|---|---|
| Standard | No. of Counts | 27 | 166 | 15 |
| Agar | Average Count | 190,063 | 54,737 | 169,520 |
| at 32° C. | Average Deviation | +16.1% | +64.3% | +228.6% |
| T-G-E-M | No. of Counts | 33 | 193 | 17 |
| Agar | Average Count | 159,558 | 46,649 | 126,918 |
| at 37° C. | Average Deviation | +21.6% | +48.0% | +50.6% |
| T-G-E-M | No. of Counts | 23 | 166 | 15 |
| Agar | Average Count | 121,778 | 70,136 | 187,620 |
| at 32° C. | Average Deviation | +54.8% | +113.7% | +263.6% |
| A.A.M.M.C. | No. of Counts | 34 | 189 | 17 |
| Agar | Average Count | 166,962 | 42,954 | 101,576 |
| at 37° C. | Average Deviation | +24.2% | +35.8% | +20.4% |
| A.A.M.M.C. | No. of Counts | 25 | 163 | 14 |
| Agar | Average Count | 222,984 | 63,292 | 201,228 |
| at 32° C. | Average Deviation | +15.2% | +90.8% | +366.5% |

This action of the committee was supported by the Coördinating Committee on Standard Methods of the Laboratory, and Food and Nutrition Sections, and by the Committee on Research and Standards, and the Governing Council of the Association.

The much greater increase in counts from incubation at 32°C., indicating that serious difficulty might be met in enforcing existing plate count limits and standards; the prospect that many public health laboratories could not be equipped with 32°C. incubators within a relatively short interval; and the difficulties of maintaining the incubator temperature at 32°C. (89.4°F.) while atmospheric temperatures sometimes exceed 38°C. (100°F.)—these practical considerations led the committee to retain 37°C. as the standard temperature of incubation. But, in order to emphasize the need for the correction of erroneous technics, the committee specified that the incubation temperature tolerance shall be in a negative direction only, and shall lie between 35°C. and 37°C.[22]

## PART II

The substitution of T-G-E-M agar for standard agar and the retention of 37°C. as the temperature of incubation having been accepted by the Association, an analysis of the data secured in the study made by the committee, for the purpose of ascertaining, if possible, the extent to which milk and dairy products plate counts may be expected to be increased by the use of the T-G-E-M agar, seems pertinent and apropos.

Before undertaking such an analysis —or, at least, before any credence is to be placed in the conclusions drawn from such an analysis—it must be assumed that the counts reported were essentially correct; and, it must also be recognized that the deductions and conclusions drawn from the analyses of these counts may be applied only to groups of counts which are also essentially correct.

### ANALYSES OF FINDINGS

The effect upon milk and cream plate counts of the change to T-G-E-M agar is of interest to milk producers, milk pasteurizers, and milk quality control authorities, particularly in areas in which the average bacterial plate count is a factor in the determination of grade, or of the premium paid for milk on the basis of the count.

The limit of deviation in an upward direction (percentage increase) permissible for a count at any given magnitude on standard agar at 37°C. to remain within certain numerical limits under other conditions of culture, is given for 4 frequently applied bacterial plate count limits, on each of Charts 1, 2, 3, 4, and 5. Counts which have fallen beyond the limits fixed are those the points of which are located in the area below the ordinate for the limiting count (30,000, 50,000, 100,000, or 200,000 per cc.) and to the right and above the curve for this limiting count.

In the following tabulations only those upper limits are used which occur in the U. S. Public Health Service Milk Ordinance.

The numbers and percentages of instances in which use of the T-G-E-M agar at 37°C. increased the standard agar counts at 37°C., beyond the limits for certain grades of milk and cream, are given in Tabulation K.

The percentages in the foregoing tabulations, it must be observed, apply only to the chance arrangements of magnitudes composing the groups on which these percentages were computed. For instance, in the case of pasteurized milk, with a limiting count of 30,000 per cc., less than 5 per cent of the counts were in the upper sixth of the range 0–30,000; but the per-

TABULATION K

PASTEURIZED MILK—UPPER LIMIT 30,000 PER CC.

| Range on Standard Agar | No. of Counts | Counts Over Limit (30,000) on T-G-E-M Agar | |
|---|---|---|---|
| | | No. | Per cent |
| Under 5,000 | 49 | 1 | 2.0 |
| 5,100–10,000 | 58 | 3 | 5.2 |
| 11,000–25,000 | 24 | 7 | 29.2 |
| 26,000–30,000 | 6 | 5 | 83.3 |
| Totals | 137 | 16 | 11.7 |

(Two of 25 counts in the range 31,000 to 50,000, inclusive, were decreased below the limit of 30,000 on T-G-E-M agar.)

PASTEURIZED MILK—UPPER LIMIT 50,000 PER CC.

| Range on Standard Agar | No. of Counts | Counts Over Limit (50,000) on T-G-E-M Agar | |
|---|---|---|---|
| | | No. | Per cent |
| Under 5,000 | 49 | 1 | 2.0 |
| 5,100–10,000 | 58 | 2 | 3.4 |
| 11,000–25,000 | 24 | 2 | 8.3 |
| 26,000–50,000 | 27 | 14 | 51.8 |
| Totals | 158 | 19 | 12.0 |

(One of the 20 counts in the range 51,000 to 100,000, inclusive, was decreased below the limit of 50,000 per cc. on T-G-E-M agar.) See Chart No. 2.

RAW MILK—UPPER LIMIT 50,000 PER CC.

| Range on Standard Agar | No. of Counts | Counts Over Limit (50,000) on T-G-E-M Agar | |
|---|---|---|---|
| | | No. | Per cent |
| Under 5,000 | 9 | 2 | 22.2 |
| 5,100–10,000 | 5 | 0 | 0.0 |
| 11,000–25,000 | 2 | 0 | 0.0 |
| 26,000–50,000 | 2 | 1 | 50.0 |
| Totals | 18 | 3 | 16.7 |

RAW MILK—UPPER LIMIT 200,000 PER CC.

| Range on Standard Agar | No. of Counts | Counts Over Limit (200,000) on T-G-E-M Agar | |
|---|---|---|---|
| | | No. | Per cent |
| Under 5,000 | 9 | 2 | 22.2 |
| 5,100– 10,000 | 5 | 0 | 0.0 |
| 11,000– 25,000 | 2 | 0 | 0.0 |
| 26,000– 50,000 | 2 | 1 | 50.0 |
| 51,000–100,000 | 5 | 1 | 20.0 |
| 110,000–200,000 | 6 | 1 | 16.7 |
| Totals | 29 | 5 | 17.2 |

TABULATION K (Cont.)

PASTEURIZED CREAM—UPPER LIMIT 60,000 PER CC.

| Range on Standard Agar | No. of Counts | Counts Over Limit (60,000) on T-G-E-M Agar | |
|---|---|---|---|
| | | No. | Per cent |
| Under 5,000 | 3 | 0 | 0.0 |
| 5,100–10,000 | 3 | 0 | 0.0 |
| 11,000–25,000 | 1 | 0 | 0.0 |
| 26,000–50,000 | 4 | 1 | 25.0 |
| 51,000–60,000 | 0 | 0 | 0.0 |
| Totals | 11 | 1 | 9.1 |

PASTEURIZED CREAM—UPPER LIMIT 100,000 PER CC.

| Range on Standard Agar | No. of Counts | Counts Over Limit (100,000) on T-G-E-M Agar | |
|---|---|---|---|
| | | No. | Per cent |
| Under 5,000 | 3 | 0 | 0.0 |
| 5,000– 10,000 | 3 | 0 | 0.0 |
| 11,000– 25,000 | 1 | 0 | 0.0 |
| 26,000– 50,000 | 4 | 0 | 0.0 |
| 51,000–100,000 | 2 | 1 | 50.0 |
| Totals | 13 | 1 | 7.7 |

centage of counts over 30,000 per cc. on T-G-E-M agar, in this sixth of the range, was 83.3 per cent.

It would be advantageous in any revision of bacterial plate count limits for grades of milk that may be necessary, if the increase in counts resulting from the use of the T-G-E-M agar might be estimated or prognosticated with a fair degree of accuracy. It appears, however, from a study of Tables I and II, that average deviations (increases) of 48.0 per cent and 21.6 per cent, respectively, resulting from plating of pasteurized milk and raw milk, respectively, on T-G-E-M agar, are by no means uniform throughout all ranges of magnitudes of counts on standard agar. In the case of pasteurized milk (Table I) there is almost a uniform decrease in the percentage deviation—all upward—between the ranges 0–5,000 and 210,000–500,000 per cc., the percentages being: 127.0, 80.3, 89.5, 71.6, 47.5, 27.2, and 7.0. Only the average deviation for the 21 counts in the range 51,000–100,000—47.5 per cent—approaches closely the average deviation for the whole group of 193 counts. In the case of raw milk the phenomenon of higher percentage deviations in the lower ranges of counts is not encountered, although the sub-groups in this group of 33 counts (Table II) are really too small to serve as representative samples. This is also true of the percentage deviations of pasteurized cream counts.

Nor is there a high degree of agreement in the percentage average increases (deviation) of counts on T-G-E-M agar (or, incidentally, on either medium at either temperature) on the part of the laboratories participating in the study (Recapitulation by Laboratories of Table I).

It appears, then, not to be possible or advisable to assume that a sample

of milk or cream yielding a count on standard agar within a certain magnitude range, would have yielded a count a certain definite percentage higher had it been plated on T-G-E-M agar; nor, conversely, that a count within a given range on T-G-E-M agar would have been a fixed percentage lower had it been plated on standard agar.

In order to check the effect of the method of determination and selection of count results upon the percentages of deviation in count, a more rigid set of criteria for closeness of correspondence between the computed counts of the two dilutions, and also between the calculated counts of the two sets of plates, was fixed. This resulted in the screening out of 55 to 63 per cent of the counts considered in the foregoing portion of this study. The same methods of analysis were applied to the smaller numbers of screened counts, with not significantly divergent results. It may reasonably be assumed, therefore, that other groups of counts determined with a degree of care comparable with those selected for this study, and of approximately the same proportionate magnitudes, would be similarly affected by the conditions of culture studied.

In Chart 6 the percentages of deviation of the screened counts are indicated by the solid spots, whereas those of the unscreened counts (other than those which appear among the screened counts) appear as open circles.

### COMPARISONS OF THE FINDINGS OF THIS STUDY WITH THOSE OF OTHER STUDIES

It is quite possible that, because of major differences in the magnitudes of the standard agar at 37°C. counts of the milks examined in these several studies, the findings with respect to the effect of T-G-E-M agar at 37°C. of, for instance, Kelly,[16] Bradfield,[20] and of this study are not closely comparable. Nevertheless, a presentation of such of the results or findings of these three reports as are of the same general nature, may be of interest.

Kelly reports that the average count of 1,051 samples of Grade A pasteurized milk was increased 46 per cent, and that of 859 samples of Grade B pasteurized milk was increased 52 per cent, when plated on T-G-E-M agar at 37°C. Bradfield obtained an increase of 104 per cent in the average count of 71 samples of pasteurized milk. (The figure 274 per cent given in Table 20 of Bradfield's report is an arithmetic average of the 71 percentages of increase or decrease in count.) The average increase in the count of 193 samples of pasteurized milk reported for this study was 48 per cent (Table I). In the case of 86 screened reports of pasteurized milk, the counts increased 54 per cent on T-G-E-M agar at 37°C.

In the case of raw milk, Kelly reports a decrease of 7 per cent in the average count of 1,157 samples plated on T-G-E-M agar at 37°C. Bradfield obtained an increase 27.1 per cent in the average count of 159 samples (Table 1 of that report). In this study an increase of 21.6 per cent was obtained in the average count of 33 samples (Table II).

As stated heretofore, these percentages of deviation (increase or decrease) in the average counts of all the pasteurized milk or of all the raw milk samples examined are not really significant. A slight change in the ratio of high to low count samples in these groups would undoubtedly have altered these percentages. This is quite clearly demonstrated when the percentage increases in average count are calculated for the progressively larger groups of counts obtained by adding cumulatively the numbers of counts in the respective ranges of magnitudes, as given in Tabulation L.

TABULATION L

CUMULATIVE PERCENTAGES OF COUNT DEVIATION PASTEURIZED MILK

| Range on Standard Agar | Bradfield T-G-M Agar | | Present Study T-G-E-M Agar | |
|---|---|---|---|---|
| | No. | Per cent Dev. | No. | Per cent Dev. |
| Under 5,000 | 19 | +596.8 | 49 | +127.0 |
| Under 10,000 | 31 | +537.1 | 107 | + 93.9 |
| Under 25,000 | 48 | +205.5 | 131 | + 92.2 |
| Under 50,000 | 62 | +131.8 | 158 | + 81.7 |
| Under 100,000 | 67 | +140.0 | 179 | + 67.8 |
| Under 200,000 | 69 | +128.4 | 190 | + 54.7 |
| Under 500,000 | 71 | +103.7 | 193 | + 48.0 |

The striking fact emphasized by this tabulation is the effect upon the percentages of increase in average count produced by the relatively smaller deviations in the counts in the higher ranges of magnitude.

In order to obtain a conception of the degree of similarity or coincidence of results obtained by the three studies heretofore referred to by eliminating or segregating the effect of the counts in the higher ranges, a comparison of

TABULATION M

COMPARISON OF FINDINGS OF THREE STUDIES
INDIVIDUAL DEVIATIONS OF COUNTS OF PASTEURIZED MILK ON T-G-M AND T-G-E-M AGAR AT 37° C.

| Study | Total | Increased | Per cent | Decreased | Per cent | Identical | Per cent |
|---|---|---|---|---|---|---|---|
| *Counts under 10,000 on Standard Agar* | | | | | | | |
| Kelly—Grade A | 963 | 687 | 71.3 | 276 | 28.7 | .. | ... |
| Kelly—Grade B | 661 | 514 | 77.7 | 147 | 22.3 | .. | ... |
| Bradfield | 31 | 29 | 93.4 | 1 | 3.3 | 1 | 3.3 |
| Present study | 107 | 94 | 87.8 | 13 | 12.2 | 0 | 0.0 |
| Total | 1,762 | 1,324 | 75.1 | 437 | 24.8 | 1 | 0.01 |
| *Counts from 11,000 to 25,000 Inclusive on Standard Agar* | | | | | | | |
| Kelly—Grade A | 74 | 46 | 62.1 | 28 | 37.9 | .. | ... |
| Kelly—Grade B | 148 | 92 | 62.1 | 56 | 37.9 | .. | ... |
| Bradfield | 17 | 15 | 88.2 | 2 | 11.8 | 0 | 0.0 |
| Present study | 24 | 18 | 75.0 | 2 | 8.3 | 4 | 16.7 |
| Total | 263 | 171 | 65.0 | 88 | 33.5 | 4 | 1.5 |
| *Counts from 26,000 to 100,000 Inclusive on Standard Agar* | | | | | | | |
| Kelly—Grade A | 21 | 10 | 47.6 | 11 | 52.4 | .. | ... |
| Kelly—Grade B | 45 | 28 | 62.2 | 17 | 37.8 | .. | ... |
| Bradfield | 19 | 14 | 73.7 | 5 | 26.3 | 0 | 0.0 |
| Present study | 48 | 39 | 81.2 | 9 | 18.8 | 0 | 0.0 |
| Total | 133 | 91 | 68.4 | 42 | 31.6 | 0 | 0.0 |
| *Counts Over 100,000 on Standard Agar* | | | | | | | |
| Kelly—Grade A | 2 | 0 | 0.0 | 2 | 100.0 | .. | ... |
| Kelly—Grade B | 5 | 1 | 20.0 | 4 | 80.0 | .. | ... |
| Bradfield | 4 | 3 | 75.0 | 0 | 0.0 | 1 | 25.0 |
| Present study | 14 | 8 | 57.2 | 5 | 37.5 | 1 | 7.1 |
| Total | 25 | 12 | 48.0 | 11 | 44.0 | 2 | 8.0 |

the numbers and percentages of the counts which were increased or decreased by plating on T-G-M agar and T-G-E-M agar at 37°C. has been made. See Tabulation M.

The groupings of count magnitude in this tabulation depart somewhat from those generally followed in this report, but were necessitated by the groupings in the report of Kelly. It is interesting to note that these groupings indicate that the T-G-E-M agar caused increases in counts even more regularly than the T-G-M agar.

SUMMARY

The results of a total of 335 milk (certified, raw, pasteurized, and certified-pasteurized) and cream (certified, and pasteurized) samples, plated on standard agar, Tryptone-glucose-extract-agar, and the American Association of Medical Commissions agar, and incubated at 32°C. and 37°C., by 7 laboratories, were analyzed.

*Pasteurized Milk*

An increase in count was observed in 70 per cent or more of the samples when plated on either T-G-E-M or A.A.M.M.C. agar, at 37°C., the average increases in count being, respectively, 48.0 and 35.8 per cent.

An increase in count was observed in 88 per cent of the samples when plated on standard agar at 32°C., the average increase being 64.3 per cent.

A cumulative increase in count was noted when samples were plated on either T-G-E-M or A.A.M.M.C. agar, at 32°C., the increases being, respectively, 113.7 and 90.8 per cent.

The T-G-E-M agar yielded generally higher counts than the A.A.M.M.C. agar, at both temperatures of incubation.

*Raw Milk*

The comparatively small number of results available for analysis places a questionable value upon the analytical findings. However, the two modified media yielded increases in individual and average counts, but the cumulative effect of incubation at 32°C. was noted only in the case of T-G-E-M agar; the average increase in count was lower in the case of A.A.M.M.C. agar at 32°C. than at 37°C.

The analysis of the results on this small group of samples appears to corroborate the findings of other investigators that increases in counts on the modified agars are not so large in samples of low-count raw milk as in samples of low-count pasteurized milk.

*Pasteurized Cream*

Increases in average counts on T-G-E-M and A.A.M.M.C. agars at 37°C. paralleled or were not greatly divergent from those of raw and pasteurized milk at this temperature. But the percentages of increase in count on the three media, at 32°C., were two- to four-fold those in the case of pasteurized milk, and five- to twenty-four fold those of raw milk.

Although the counts of pasteurized cream were few in number, the findings were similar to those obtained in previous studies, in that there was distinct indication of the presence in these cream samples of bacteria which grow well at 32°C., even on standard agar, but do not develop at 37°C., even on the improved agars.

The use of T-G-E-M agar, selected as the standard after July 1, 1939, may be expected to increase beyond the legal limits such counts as on standard agar were, or would have been, close to the legal limit. This, however, will affect only milk supplies the counts of which, on standard agar, have not presented a true picture of bacterial content.

The findings of this study do not deviate significantly from those of previous investigators.

## CONCLUSIONS

1. Because of the relatively small numbers of plate counts of raw milk and cream, and of pasteurized cream considered in this study, conclusions may be drawn with confidence only from the analyses of the data on pasteurized milk. The use of tryptone-glucose-extract-skim milk (T-G-E-M) agar at an incubation temperature of 37°C. resulted, in 60 to 90 per cent of the cases—varying inversely with the magnitude of the count—in an increase over the plate count on standard nutrient agar.

2. The percentage of such increase in count was extremely variable, although the percentage of average increase was greater in the lower than in the higher ranges of counts on standard nutrient agar.

3. In general, higher counts resulted from the use of T-G-E-M agar than from the use of the American Association of Medical Milk Commissions (A.A.M.M.C.) agar at incubation temperatures of 32°C. and 37°C., although the difference in average counts did not exceed 10 per cent.

4. The results of this study parallel those of other studies conducted, and corroborate the conclusions drawn therefrom.

5. There is no indication of a fixed ratio between counts on standard nutrient agar and those obtained by the use of either of the other media.

6. It follows that attempts to correlate or translate counts on T-G-E-M or A.A.M.M.C. agar to what they would have been had standard nutrient agar been used, or vice versa, are likely to be misleading.

7. Incubation at 32°C. in combination with the use of the modified agars, resulted in increases in plate count of considerably greater magnitude than were obtained by the use of these agars and incubation at 37°C.

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# The Care of Premature Infants*

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THE fate of the premature infant depends on a number of factors, among which are the health of the mother during pregnancy, the degree of the infant's immaturity at birth, and the care that is received by the infant after birth.

Methods of caring for premature infants have been determined largely on a trial-and-error basis rather than on a scientific one. The lack of adequate study and evaluation of such methods from the clinical and the experimental points of view has been due largely to the lack of realization of the magnitude of the problem and of the results that may be expected when increased efforts are made to reduce the mortality among premature infants.

It is true, of course, that infants weighing at birth less than 1,000 gm. (2.2 lb.) rarely survive. Since weight in itself is not an exact measure of maturity, this criterion should not be used alone to judge viability. Some obstetricians state that an infant weighing less than 1,500 gm. is "previable." There are, however, a large enough number of records of the survival of infants weighing at birth less than 1,500 gm., and even less than 1,000, to warrant efforts to save such infants, regardless of the size or maturity of the individual infant. Hoffman [1] and his coworkers have reported the case of a premature infant that lived, although it weighed at birth only 735 gm. (1.6 lb.). In Figure I this infant is shown at 23 days, and in Figure II, at 35 days. Figure III shows the initial loss in weight and the gain up to the age of 100 days. Figure IV shows the infant at 1 year, weighing 17 lb., 5 oz.†

Statements are found in the literature that when these small infants survive, a large proportion of them, even if they develop physically, show more or less mental retardation. These statements, however, have not as a rule been based on acceptable psychological tests, nor have satisfactory controls been used. That premature infants develop normally—both physically and mentally—as do full-term infants has now been well established through the work of Hess, Mohr, and Bartelme,[2] and of Gesell [3] in the United States, as well as by that of von Sydow [4] and Melcher [5] in Europe, and a number of other investigators. For example, Hess, Mohr, and Bartelme [2] state: ". . . our comparisons of two groups of prematurely born children . . . with full-term children . . . indicate that premature birth unassociated with intracranial injury

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*Courtesy of Samuel J. Hofman, M.D., et al., and the J.A.M.A.*

FIGURE I—Premature infant 23 days old. Birth weight, 735 gm.

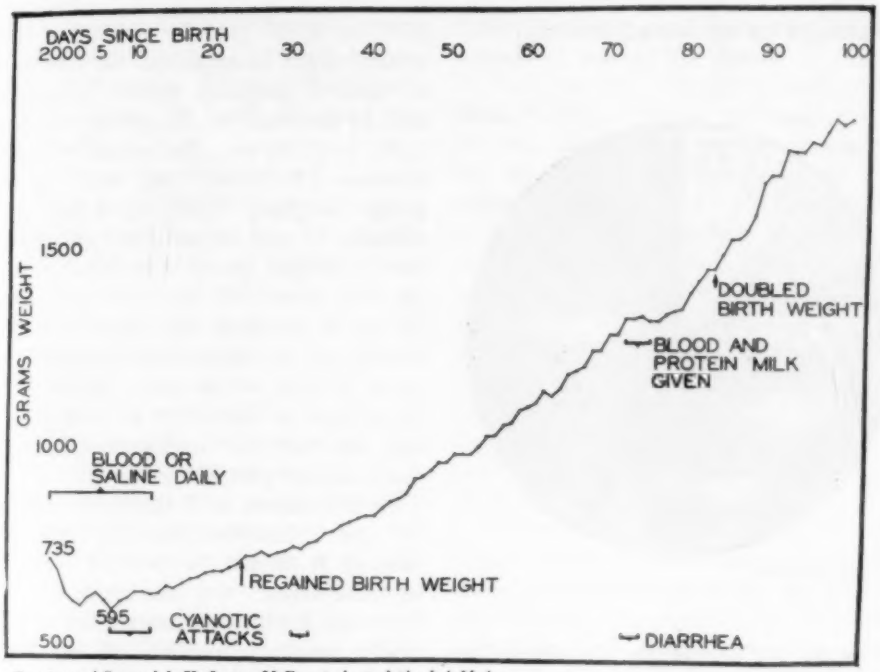
does not affect mental development." The conclusions of these specialists in the field of pediatrics and psychology have been well expressed by Gesell [3] as follows: "Present data, though scanty and sometimes contradictory, indicate that prematurity of birth in itself does not markedly distort, hasten, or retard the course of mental development when the age of the infant is reckoned from conception."

How many babies are born prematurely each year? As premature birth is not reportable throughout the United States Birth Registration Area, and as data in this regard are not compiled by the Bureau of the Census, the answer to this question is not known except on the basis of special studies. The Children's Bureau,[6] in a study of nearly 23,000 live births occurring in 8 cities, found that 5 per cent were premature. A recent report by the Metropolitan Life Insurance Company [7] of a survey made in 13 leading hospitals in the United States showed that slightly more than 5 per cent of the 141,098 live births that occurred in these hospitals during the period 1933–1936 were premature. In New York State, exclusive of New York City, more than 4 per cent of the 82,000 infants born alive in 1936 were reported to be premature.[8] In Chicago slightly more than 4 per cent of the 97,000 infants born alive in 1936 and 1937 were reported to be premature.[9]

There were in the United States 2,144,790 live births in 1936.[10] If an estimate is made that 4 per cent of these live births were premature, more than 85,000 infants were born prematurely in that year. Such an estimate obviously does not take into account geographic or racial variations or the social and economic factors that have

*Courtesy of Samuel J. Hofman, M.D., et al., and the J.A.M.A.*

FIGURE II—Same infant 35 days old.




*Courtesy of Samuel J. Hoffman, M.D., et al., and the J.A.M.A.*

FIGURE III—Initial loss and gain in weight.

been shown to influence the incidence of premature birth, but it is believed that this 85,000 is an underestimate rather than an overestimate of the number of infants born prematurely in the United States each year.

The mortality rates among premature infants under 1 month of age are high —between 15 and 16 deaths per 1,000 live births (in the period 1933–1936). In Figure V, which shows the causes of mortality in the first month of life, it can be seen that 81 per cent of the deaths are due to prenatal and natal causes. Almost half, 46 per cent, are due to premature birth.

In the 6 years, 1931–1936, there has been practically no decrease in the mortality rate from premature birth, and in the past 22 years a very slight decrease—from 17.7 in 1915 to 15.1 in 1936. In 1936, the latest year for which such information is available, there were in the United States 32,452 deaths in the first month of life that were reported as due to premature birth.

These mortality rates from census re-

*Courtesy of Samuel J. Hoffman, M.D., et al., and the J.A.M.A.*

FIGURE IV—Same infant 1 year old. Weight, 17 lb. 5 oz.

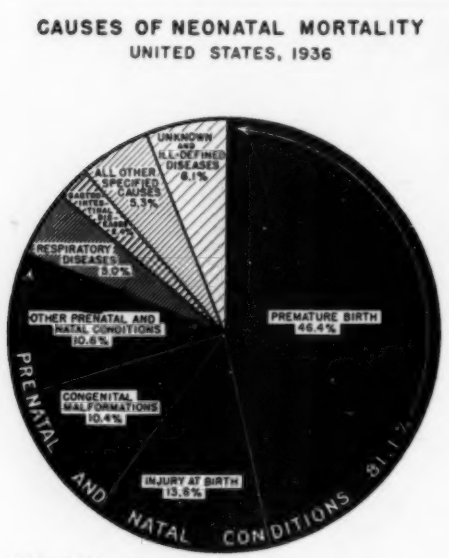



FIGURE V

ports do not permit the drawing of as accurate conclusions as would be possible if a standard for reporting an infant as premature had been used by the physicians who signed the death certificates. The consensus of opinion expressed in a resolution by the American Academy of Pediatrics,[11] is that all infants born alive who weigh at birth 2,500 gm. (5½ lb.) or less should be treated as premature regardless of period of gestation, crown-heel length, or any other criterion of prematurity. This is the same weight as that recommended as a criterion by the British College of Obstetricians and Gynaecologists.[12] Using this criterion of prematurity—a birth weight of 2,500 gm. or less—7 hospitals have made available to the Children's Bureau comparable reports on more than 4,000 premature infants. Since the mortality among premature infants is highest for those with comparatively low birth weights and lowest for those with comparatively high birth weights the infants reported on by each hospital were studied in four weight groups. In the group of infants in the highest weight group weighing 2,001 to 2,500 gm., in which the best results might be expected, the mortality in these 7 hospitals varied between 6 and 14 per cent; in the group weighing 1,501 to 2,000 gm., the mortality varied between 22 and 45 per cent; in the group weighing 1,000 to 1,500 gm., between 57 and 84 per cent; and in the lowest weight group (less than 1,000 gm.) between 85 and 100 per cent. In the 7 hospitals the total mortality among the premature infants varied between 20 and 34 per cent. From these variations in mortality it is apparent that the mortality among premature infants can be greatly lowered.

In connection with the data reported by the 7 hospitals to the Children's Bureau it should be pointed out that in these reports the infants in the two lower-weight groups constituted a relatively small proportion of all those weighing 2,500 gm. or less—4 and 11 per cent respectively—whereas those in the two higher-weight groups constituted 26 and 58 per cent of the whole group. That these proportions hold in a series of live births that include both mature and premature infants can be seen in Figure VI, in which nearly 2,800 infants born alive in New Haven Hospital, 1928–1932, are represented. Of all the infants weighing 2,500 gm.

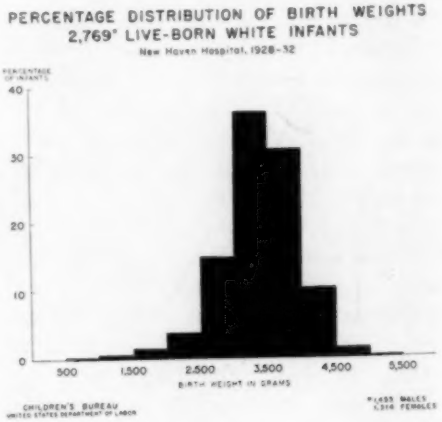



FIGURE VI

or less, those in the lower-weight groups constituted 2.4 and 10 per cent respectively, and those in the two higher-weight groups 25 and 63 per cent respectively.

The advantage of a standard measure, such as a weight of 2,500 gm. (5½ lb.) or less, to apply when determining the need for special care of premature infants has been pointed out. When such a measure is used statistics can be compiled which make it possible to gauge the success of methods of care, to compare the results of these methods with those used by other workers, and to evaluate new methods of care.

In recent years considerable publicity has been given to the need for the reduction of mortality among premature infants. The Conference on Better Care for Mothers and Babies, held January, 1938, and the National Health Conference, held July, 1938, both stressed the need for reducing neonatal mortality, especially mortality among premature infants.

Thirty years ago three principles for the care of premature infants were enumerated by Rommel.[13] These are: maintenance of body temperature, proper feeding, and protection from infection. Rommel emphasized the importance of applying warmth immediately after birth and of keeping the infant in a *warm* room. In discussing artificial warmth for the premature infant he named the following among the qualities required in an incubator: simplicity and sureness in operation; cleanliness; ventilation and moistened air (the humidity should be about 60 per cent); accurate regulation of the temperature at 79° to 82° F. He added, "We must admit unfortunately that despite the greatest care there is hardly an existing model which fulfils all these demands." Heated cribs, hot-water bottles, and so forth, were mentioned by Rommel in this connection, and the advantage of these, he stated, is that the "breathing air" does not become heated.

For feeding, Rommel advocated mother's milk "above all things" and stressed the importance of calculating the amount of milk required by the infant so as to avoid overfeeding or underfeeding. The caloric requirement, he stated, varies "from 130–120–110 calories per kilo of body weight, diminishing with the increasing weight and age of the child." Feedings should be at 2 hour intervals or even shorter ones—10 to 20 feedings in 24 hours. Gavage, or else feeding by means of a pointed spoon, must be employed in feeding very small infants.

Rommel recognized infection as dangerous to the premature infant and stated that prevention may be accomplished most successfully by "skillful attendance." Among therapeutic measures he mentioned the use of oxygen and "injection of artificial serum (20–30 cc.)."

These principles of care, set forth 30 years ago, are still generally accepted as in the main correct but, unfortunately, are far from being generally applied.

What contributions to the knowledge of methods of care of premature infants have been made in recent years? Very little progress has been made, but some of the principles already mentioned, which were developed empirically or from clinical observations, have been established on a more or less scientific basis.

In applying the first principle of care of the premature infant, namely, regulation of the body heat, the air conditioned room has been developed, in which both temperature and humidity are controlled automatically. The old-fashioned incubator has been replaced by modern types of electrically heated beds, the temperature of which is regulated by thermostat. In such a bed the infant breathes the air of the room or

an air mixture that can be controlled. Simpler and less expensive types of heated beds or heated hoods to use on ordinary bassinets or beds have been developed; one of these heated hoods is shown in Figure VII. This is modeled on the type developed by Nobel, modifications of which have been described by Parmalee [14] and by Livingston.[15] In all these types the infant's head is outside of the heated bed and he is breathing the room air. For use in transporting the infant from the delivery room to the special nursery for premature infants, or from home to hospital, heated units have been used which cover the infant completely but allow for ventilation through windows, the size of which can be altered.

Hess and his coworkers [16] have shown that by education of parents and physicians so that they send premature infants immediately after birth to a hospital, and by putting such infants in a portable heated bed for transportation to the hospital the mortality among such infants can be appreciably reduced.

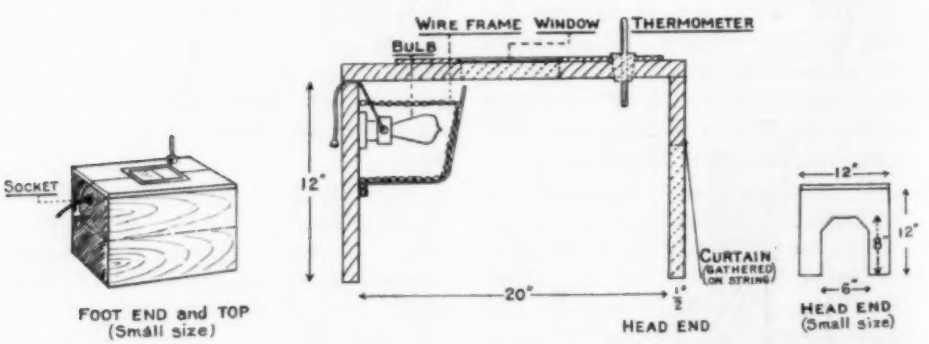
Blackfan and Yaglou [17] have studied in air conditioned nurseries the effect of varying temperature and humidity relationships on the well-being of the premature infant, and conclude that a humidity of about 65 per cent and a temperature ranging from 75° to 100° F. constitute optimal conditions.

In regard to feeding premature infants, the consensus of opinion holds that breast milk is the safest food. Some authorities state that when small amounts of breast milk must be given, the milk should be fortified by the addition of carbohydrate.

In using artificial feeding it is, of course, important to consider certain peculiarities of the premature infant when compared with the mature infant. It has long been known that premature infants often show marked difficulty in fat absorption, and Tidwell and his coworkers [18] have demonstrated that certain fats are better absorbed than others. It has long been known that the protein requirements of premature infants are high. Darrow and Cary [19] have found the total proteins of the blood of premature infants to be low, chiefly because of its low globulin content.

The total caloric and fluid requirements of the premature infant must be accurately calculated. The metabolism

FIGURE VII




ELECTRICALLY HEATED HOOD TO BE USED ON PREMATURE BABY'S CRIB

*Children's Bureau*

of the premature infant was first studied by Benedict and Talbot.[20] Gordon and Levine,[21] using a specially constructed chamber, have also studied the metabolism of premature infants and have made important recent contributions to the knowledge of the caloric and fluid requirements of these infants in relation to body weight and environmental temperature.

The tendency of the premature infant to develop anemia and the importance of beginning anti-anemic therapy shortly after birth have been demonstrated by Josephs[22] and by Davidson and Merritt.[23] The work of Davidson, Merritt, and Chipman[24] also has confirmed the long recognized fact that the rapid growth of premature infants makes them prone to develop evidences of vitamin D deficiency, and has shown the importance of beginning effective preventive therapy early. Park[25] states that to prevent rickets in a premature infant "it may be necessary to give 1,000, 5,000, or 10,000 units, or for a time even more daily in the form of the highly concentrated fish-liver oils, viosterol in oil, or other vitamin D preparation." Goodwin[26] has pointed out that administration of cod liver oil to small, debilitated infants is often fraught with danger, as the swallowing reflex may be inactive and therefore the oil may be aspirated, whereupon lipoid cell pneumonia may result. In view of this danger it is wise to use a concentrated preparation of vitamin D of known potency in a non-oily mixture.

It has been suggested that the premature infant probably lacks certain hormones that are transmitted to the full-term infant through the placenta shortly before or during birth. Some hormones have been administered to such infants, but the benefits derived from them have not as yet been well established.

Bakwin[27] has shown that the cyanosis so commonly seen in premature infants may be due to anoxemia, which can be relieved by the administration of oxygen. A supply of oxygen and proper apparatus for administering it to small infants should be readily available wherever a premature infant is being cared for.

The importance of preventing infection in premature infants has been stressed in efforts that have been made to establish standards for the care of premature infants in hospitals. Those established by Hess[28] in the premature unit of the Sarah Morris Hospital have been adopted by the Department of Health of the City of Chicago as part of a city-wide campaign to reduce mortality from premature birth. These include individual equipment for bathing and feeding the infants, proper arrangements for disposal of soiled diapers and linen, exclusion from duty of attendants and nurses with infections, wearing of gowns and masks and washing of hands by attendants, nurses, and physicians, running water readily accessible, and isolation of infected infants. In addition, a regulation of the Department of Health requires that the birth of a premature infant be reported within 24 hours after it occurs.

For transportation to the hospital the infant is placed in a heated portable "ambulance"; the hospitals in the city have been studied and graded according to the facilities afforded for special care of these infants and minimum requirements for hospital care have been set up. These include in addition to those already enumerated the provision of some type of heated bed, a supply of oxygen with necessary equipment for administering it, a thermometer and hygrometer in the infant's room, and—particularly important—provision of qualified nursing personnel. Notification of the board of health is required before the infant is discharged from a hospital. In addition to these requirements certain recommendations are

made, such as attendance of a pediatrician in the delivery room, prompt transfer from delivery room to special nursery, breast feeding, and separate room for care.

Standards for the care of premature infants in hospitals are at present under discussion by a committee on premature infants, appointed by the Commissioner of Health of New York City, and composed of representative pediatricians and obstetricians, the object being to reduce morbidity and mortality among premature infants.

With the same object in view the Division of Research in Child Development of the U. S. Children's Bureau is coöperating in studies of premature infants at New York Hospital. Metabolic studies are being made to determine the food and water requirements of these infants. In addition, a follow-up clinic is being developed at this hospital to improve home care and to obtain data in regard to social and economic as well as health factors affecting the welfare of these infants. The causes of premature birth will also be investigated. Knowledge of these causes is necessary in order to reduce the incidence of premature birth. This aspect of the problem has been greatly neglected.

These programs reflect the increasing interest in the problems of the reduction of mortality from premature birth, as do the most recent plans submitted by the maternal and child health divisions of the various states to the Children's Bureau for approval under the terms of the Social Security Act.

Eight of the 48 states, as well as the District of Columbia and the Territory of Hawaii, have some plan contemplated or already in operation for improving the care of premature infants. The most complete plan is that now being carried on by Massachusetts under the direction of a special division of the health department with a full-time physician in charge. This program includes enactment of a law making premature birth reportable, establishment of hospital centers for the care of premature infants, and an educational program for physicians, nurses, and mothers. The preventive aspects of the problem are stressed by encouraging the establishment of prenatal centers in hospitals and communities.

The state health departments of New York, Tennessee, West Virginia, Colorado, and Nebraska have provided special warm beds for distribution; those of Wyoming, South Dakota, and Hawaii have planned to provide such beds. Special booklets on the care of the premature infant have been published by the divisions of child hygiene of the state health departments of Massachusetts and West Virginia, and by the U. S. Children's Bureau.

Successful reduction of morbidity and mortality among premature infants requires not only use of the most efficient methods now available for caring for such infants but also continued alertness to the need for the development of more efficient methods of care. Education of parents, nurses, and physicians in the special care of premature infants at home and in hospitals will without doubt save the lives of many premature infants.

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# Effectiveness of Different Systems of Collecting Vital Statistics Data*

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WHILE the United States has the distinction of being the first country in the world to provide in its Constitution for a periodic enumeration of population, the general acceptance of the importance of recording births and deaths came about very slowly. It was only 5 years ago that a nation-wide system of registration was finally achieved. When one considers that England has had accurate birth and death statistics for 100 and Sweden for almost 200 years, the impulse toward self-criticism is quite natural. It is important to realize, however, that in all logic, comparison should be made not with individual countries but with the entire continent of Europe, not only because of the magnitude of the area of the United States but the fact that it is composed of many autonomous units exhibiting wide geographical variations and important differences in historical tradition, customs, and economic conditions.

Some of the original states evinced as strong an interest in registration as any of the countries of the Old World. Chronologically, the first place in this field belongs to Virginia, which as early as 1632 enacted a law requiring ministers and church wardens to report marriages, births, and deaths. And by the way, certain procedures set up by this law have remained unchanged for three centuries and were modified only a few years ago. A law similar to that of the colony of Virginia was passed by Connecticut in 1644, by Massachusetts Bay Colony in 1639, and New Plymouth in 1646. The "Fundamental Constitutions" prepared in 1669 for the government of Carolina by the Philosopher John Locke contained stringent provisions for "a Registry in every Seigniory, Barony, and Colony, wherein shall be recorded all the births, marriages and deaths that shall happen." According to one writer, "Massachusetts was the first state in the Christian world which recorded births, deaths, and marriages by government officers," as such instead of baptisms, burials, and weddings. The first registration law of modern type was enacted in Massachusetts in 1842 as a direct consequence of the English law of 1837, which made statistics the foundation of modern sanitary progress.[1]

In 1847 the United States National Medical Convention, meeting in Philadelphia, urged upon the various state governments "the adoption of measures for procuring the registration of births, marriages, and deaths occurring in their several populations." The Convention, pointing to the "ordinary

* Read before the Vital Statistics Section of the American Public Health Association at the Sixty-seventh Annual Meeting in Kansas City, Mo., October 25, 1938.

purposes for which such registration should be universally adopted, such as proofs of lineage, rights of dower, and bequests of property," considered the following as the more vital reasons:

> First, upon the circumstances connected with the three important eras of existence, birth, marriage, and death, are dependent, to a large extent, the physical, moral, and civil condition of the human family.
>
> Second, a knowledge of these circumstances is necessary for a full comprehension of important means for the certain advancement of the population of states, in prosperity and civilization.[2]

The example of Massachusetts was followed by other states but progress ceased when the Civil War and its social sequelae occupied the attention of the country to the exclusion of everything else. Agitation in favor of state registration was resumed in the last quarter of the 19th century, but as it was then observed by Dr. Cressy Wilbur, the completion of the task could not come about spontaneously for a long period of time. Dr. Wilbur placed the achievement of the goal as far ahead as the end of the 20th century. That this goal was reached much earlier than had been anticipated was in the main a result of the activities of the Bureau of the Census after its establishment in 1902 on a permanent basis and the energetic coöperation of interested professional and commercial organizations. Another factor, of perhaps equal importance, was the unforeseen growth of ways of communication.

In the history of registration in this country, three distinct stages are discernible. The first, when the formulation and enactment of legislation was largely a matter of local initiative; the second, during which the Bureau of the Census and various unofficial agencies actively concerned themselves with the development of local registration, furnishing advice, technical and, in many instances, financial assistance. We are now in the third stage, which is in a sense a synthesis of the first two: satisfactory legislation laws have been enacted by all states, which are now directing their energies toward as near an approach as possible to the ideal of complete, timely, and accurate registration and the utilization of records for the public welfare, with the Bureau of the Census acting in an advisory and coördinating capacity.

The function of registration is exercised by the state departments of health with the single exception of Massachusetts, which places this duty upon the Secretary of the Commonwealth.

In order to make possible an intelligent discussion of the subject of this paper, all state registration officials were asked to reply to the following two questions: (1) How are the birth, death, marriage, and divorce records forwarded to the state office? (2) What, in your opinion, is the most satisfactory system for the collection of vital statistics data?

A summary of the comprehensive communications which my colleagues from 36 states were good enough to send me follows:

In 4 states all birth and death certificates are either filed with the county health officers, who transmit them to the state department, or are routed by the local registrars through the county health departments.

In 12 states the certificates are sent direct by the local registrars to the state departments. In one of these states the local registrars also send copies of the certificates to the county health officers.

Twenty states combine the two preceding methods: the certificates are forwarded by local registrars direct to the state department of health, except that in counties having health departments or in sections of states having full-time health units the certificates are sent to these departments or units

for transmission to the state department.

Central registration of marriages is provided for in 23, and central registration of divorces in 10 of the 36 states. In 3 states the state departments receive *copies* and not the original documents.

Birth and death records are forwarded to the central office once a month with the exception of one state, in which the birth records are forwarded once a year, and one other state which provides for the weekly forwarding of these records. The latter arrangement permits the nursing service of the state department of health to establish contact with a family in which there is a new baby within one or two weeks after delivery.

In most of the states, marriage and divorce records are forwarded to the state office once a month; in a few states the records are filed either quarterly or annually.

The views of the state registration officials on the most satisfactory method for the collection of vital statistics data may be grouped into three classes:

1. The original system, which provided that birth and death records should be forwarded by local registrars direct to the state office, has proved its worth and should not be tampered with.

This position is clearly presented by David South, State Registrar of New Jersey: "I am of the opinion that since the present system is so well established and appears so satisfactory, little would be gained by routing the certificates through county health departments. Surely such a procedure would result in a greater loss of records in transit and delay in the filing of records with the state office."

Gerda Pierson, Director of the Minnesota Division of Vital Statistics, is unequivocally opposed to the forwarding of records through a county health department because "Re-routing the returns would undoubtedly result in delay in their reaching the Department." To meet an anticipated argument, she adds: "The county health officers are furnished much statistical data and other information they desire for their counties by the Division of Vital Statistics, and they have means of securing any special information they may desire in a hurry from the local registrars or other source in the county."

2. The efficient functioning of state registration requires the abolition of local districts in favor of larger units, preferably on a county basis.

Dr. Maysil M. Williams, State Health Officer of North Dakota, is an eloquent advocate of this proposal:

Small registration districts were necessary in the early days, but with the universal use of automobiles and efficient postal service the distance between local registrars could be increased without jeopardizing the efficiency of registration. A physician's practice in rural areas extends for 15 or more miles into surrounding territory. This necessitates knowledge of many local registrars who are changing annually . . . Personal contact and instruction by the State Registrar is impossible due to the large number. Consideration is being given a plan in which there would be one local registrar in each county, with subregistrars where needed for the purpose of issuing burial and removal permits.

In Nevada, says Dr. John E. Worden, Health Officer of that state, the small population is scattered over such a large area that the county system "is the only practical method," local registrars being retained in a few of the isolated places where there is no local physician.

3. Local registration districts should be retained but in counties having full-time health departments the birth and death records should be routed through these departments.

Dr. W. J. V. Deacon, Director of the Michigan Bureau of Records and Statistics, considers this "the ideal system of registration."

In New Mexico, according to Miss Billy Tober, State Registrar, "The

intermediary stage is essential for the proper operation of county health work." Besides, "progress (in the registration of births and deaths) would not have been made if the personnel in the county health departments . . . had not spent some time on registration work."

Dr. Franklin H. Reeder, State Registrar of West Virginia, finds that the routing of certificates through a county health department "is not only a service to the county health officer, but by keeping his interest in registration alive it often makes him a valuable ally."

In my opinion, the weight of the argument is definitely in favor of the third point of view. Those state registrars who oppose the routing of certificates through county health departments or district state health offices base their opposition on the possible risk of loss of records in transit and delay in the receipt of certificates in the central office. However, if local registrars continue to report to the state office the *number* of births and deaths recorded with them each month and if the county or district office functions properly, the risk of loss of certificates cannot be considered a serious matter. The delay in filing the certificates with the central office need not exceed a few days—sufficient to allow the county or district office to copy and to forward the certificates to the state department of health.

Basic to the entire discussion is the question: Can a county health department or district state health office function efficiently without immediate knowledge of the occurrence of births and deaths in the territory under its jurisdiction? I am not an expert in local health administration, but even superficial acquaintance with it obliges me to reply in the negative. Several registrars have stated that a county health department can secure the necessary statistical guidance from the state office or, if pressed for time, can get the information it desires from the offices of the local registrars. I doubt if a county or district health office could do its best work on a diet of canned statistical food. A complete statistical table prepared in keeping with all rules of statistical practice is one thing, while first-hand acquaintance with the original birth and death certificates is an altogether different matter. The day by day picture of developments in the county or district which a health office needs for proper functioning cannot be supplied even by the most elaborate monthly reports compiled by the state office. As for visits to local registrars, it would be clearly impossible for the county staff to undertake them with the necessary frequency.

In considering the situation in the country as a whole, one is led to the conclusion that here, as in many other elements of our national life, there is no single system that will best serve the needs of the people of all states. In a state like Nevada, with 0.8 person per square mile, efficient registration can be achieved, perhaps, only through the substitution of county for local registrars; while in Delaware, for example, where the density of population is 102 persons per square mile, and where according to Dr. A. C. Jost, State Registrar, even the farthest removed local registrar is within an hour's drive from the state office, registration on a county basis would be nonsensical.

The difficulties of devising a uniform system have been clearly depicted by Dr. W. W. Hubbard, Director of the Tennessee Division of Vital Statistics:

> The state is divided into three distinct geographic areas, each having different population and racial distributions, different natural barriers, and a varying distribution of medical facilities, such as hospitals, physicians, etc. Many states have similar prob-

lems. There is probably no uniform system that could be used satisfactorily in all localities . . . It seems desirable to fit the collection system to general area problems. In some communities, it seems best to put all collection into the hands of local health departments, and eliminate intermediate handling by registrars. In some rural areas a local registrar for each minor civil district is imperative. In other counties, consolidation of registration districts is proving effective.

My own belief is that unless conditions make it impossible, the framework of a state registration system should consist of local registration districts, county and district state health offices being used as intermediary stages, *provided these offices have adequate equipment and personnel.* For this reason, the necessary legislative provision should be made optional and not mandatory. In New York State, for example, the desirability of introducing the intermediary stage and its continuance is in each individual instance governed by the judgment of the state commissioner of health. At present this system is effective in all of the 6 counties which have a full-time health department and in 1 state health district comprising 2 counties. The system will be extended to the other health districts when in the opinion of the state commissioner of health they are able to undertake this function.

It may be advantageous at times to consolidate two or more local districts; such consolidations, however, should be made only after a study of local conditions. There is no need for having separate registration districts in a village and a town if, as it often happens, the town registrar is also town clerk and the town hall is located in the village. On the other hand—to recall a recent case—consolidation would be definitely against the public convenience if the township were cut in two by a mountain range which is barely passable in inclement weather. The merits of one or another system must be weighed in terms of our basic objective—complete, timely, and accurate registration of all births and deaths. Short-cuts may be considered only if they do not endanger this aim.

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1. Wilbur, Cressy L. *The Federal Registration Service of the United States, Its Development, Problems, Defects.* Government Printing Office, Washington, 1916.

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## DISCUSSION

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I VERY cordially agree with the idea that birth and death records should pass through the hands of the full-time county health office before reaching the central office of the State Department of Health.

It has been my observation that health officers ten or twelve years ago minimized the importance of vital statistics records in their counties, and, in fact, at that time I could secure very little coöperation from these officials in my efforts to obtain as near 100 per cent registration as could possibly be done.

The health officer was fully alert to other duties such as school examinations, vaccinations, and public health education in general, but it seems that he considered vital statistics of very

minor importance in his program, not realizing, of course, the leading position which these statistics should have occupied in planning his various and sundry public health endeavors.

In recent years, however, it has been noted that the health officer not only realizes his need for vital statistics, but is keenly alive to any suggestion which may be made to him for obtaining a full and complete report of every birth and death occurring in his territory. Also, they are asking and demanding that we place in their hands the birth and death certificates of their sundry counties before such records are forwarded to the central office.

Our health officers are not only making immediate use of these statistics for guides in public health work, but they are keeping card records of births and deaths in their files from year to year.

It adds very much to the prestige of the county health department to be able to give information locally, especially to school authorities with reference to ages of children first entering school. Also, this ability to show the information needed relieves the central office of a great deal of searching among the records for identical purposes.

It seems reasonable to me that since conditions have changed to such a remarkable extent within the past 25 years, every state should seriously consider the proposition of whether or not its methods of gathering birth and death certificates have changed with the times. In the year 1912, when our State Department was first organized, there were scarcely any automobiles, no good roads, the doctors were scattered throughout the rural communities, and home-made coffins were used in a large percentage of burials throughout the rural areas of our state. Undertakers were, of course, operating within the larger towns, but very few of them attended to funerals at a greater distance than 12 miles away from their places of business.

At this time we can travel almost anywhere in the State of Mississippi in any sort of weather, and although we have been somewhat behind with building fine highways, we are now spending millions of dollars in the construction of modern roads. The doctors, as a rule, have congregated in the towns, the undertakers travel sometimes as far as 200 miles to bury the dead, and it does seem to me that we have no reason to cling to antiquated methods of filing birth and death certificates. Therefore, we now have barely more than 100 registrars of vital statistics in Mississippi, whereas, 10 or 15 years ago, we had over 1,000. In order to make smoother the operations of the county registrar, it was necessary to abolish the burial permit in all communities of less than 5,000 population. Of course, we require a transit permit for all bodies shipped out of Mississippi into other states.

As I have stated heretofore in these meetings, it is no more logical to require an undertaker to obtain a burial permit, than it is to force a physician to get a permit to attend a birth. No one seems to argue any other motive for the burial permit than to make, or attempt to make, more certain the filing of the death certificate. Our experiences in Mississippi show that the undertaker will come just as near filing the death certificate without obtaining a burial permit as he did when he had to obtain one, and, to tell the truth, his death certificate is more accurate when given a little time for its completion than it was when he had to get it ready to trade in for a burial permit before the body was disposed of.

However, I am ready to grant that in some states it is easier for an undertaker to prepare a death certificate and

obtain a permit before disposition of the body than it is in a state with a great deal of rural territory.

From what I have learned so far, several southern states have made much headway in consolidating registration areas. It seems they are not eliminating the burial permit, but the methods they prescribe for such permits seem to me to be rather crude, and constitute ample proof that this formality is unnecessary.

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# The Nine Plank Platform of Andriya Stampar

DR. Andriya Stampar, of Yugoslavia, one of the great contemporary public health administrators, is visiting this country this summer. His own summary of his views on public health is reproduced below[1]:

(1) The education of the people is more important than laws, and for this reason our work (in Yugoslavia) is based upon three small laws only.

(2) It is most important to prepare a correct attitude of society towards questions of public health.

(3) The question of public health and of the work done for its advancement is not a monopoly of the doctors; but everyone, without distinction, should take part in it. It is only by means of this universal coöperation that public health can improve.

(4) A doctor should be mainly a social worker; he cannot go far with individual therapy alone—social therapy provides the means that can lead him to real achievement.

(5) A doctor should not be economically dependent on his patients because such dependence hinders him in the most fundamental of his tasks.

(6) In respect to public health no distinction should be made between the rich and the poor.

(7) It is necessary to create a health organization in which the doctor shall seek out the patient, and not the patient the doctor, for it is only by so doing that the ever-increasing numbers of those whose health we should protect can be included in our care.

(8) A doctor should be a teacher of the people.

(9) The question of public health has more of an economic than a humanitarian significance. The chief place for a doctor's work is in the dwellings of the people—the places where men live and work—and not in laboratories or in a doctor's consulting-rooms.

1. From Sigerist, H. E. Yugoslavia, *Bull. of the History of Medicine* 7:99, Jan., 1939.

The story of Doctor Stampar and his career as chief of the Department of Public Hygiene in the Ministry of Social Institutions of Yugoslavia is told by Louis Adamic, in Chapter XVI, *The Native's Return* (New York: Harper & Bros., 1934).—New York State *Health News*, July 3, 1939.

# Infection of Air*

## Bacteriologic and Epidemiologic Factors

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CONCENTRATION of microörganisms in air (the number dispersed in unit volume) implies some degree of confinement. The potential hazard of infection from the air breathed in the semi-confined spaces of our habitations may be represented for any moment in time by the equilibrium between the addition rate of microörganisms and the rate of their elimination. A bacteriologic technic for the measurement of sanitary ventilation, inversely determining confinement, has been previously described.[1] The rate (K) at which bacteria suspended in semi-confined atmospheres are vented or killed may be determined directly, and changes in ventilation rates may be computed from the formula P=C/K where the equilibrium (P) is measured and the rate of addition (C) of bacteria is maintained constant.

### CONFINEMENT OF AIR-BORNE MICROÖRGANISMS

If air displacement alone in ventilated rooms is to be measured, no advantages are claimed for bacteriologic procedures over gasometric methods.† In measuring infection and disinfection of air, however, the bacteriologic procedure offers a means of interpreting biologic ventilation in terms of air replacement. The rate at which viable microörganisms disappear from a semi-enclosed atmosphere through physical, chemical, or biological means can be expressed as equivalent ventilation (based upon air replacement).

The importance of distinguishing between the hygienic potentialities of bacterial ventilation by air displacement and by other means of disinfecting habited atmospheres has become evident from analysis of some 1,750 air samples, collected in studies on sanitary ventilation to be reported later. During the winter months, associated

* This study is supported by a grant from the Commonwealth Fund to the University of Pennsylvania for investigations on air-borne infection, with laboratories in the Department of Bacteriology, the Children's Hospital of Philadelphia, and the Henry Phipps Institute for the Study, Treatment, and Prevention of Tuberculosis.

† The equilibrium formula applies equally well if $CO_2$ is added to a room at a known constant rate (C). Let the rate of addition of $CO_2$ per person per hour (C) be 0.5 cu. ft.[2] With an air space of 200 cu. ft. per person,[3] the addition rate (C) = 0.5/200 = 0.0025 volumes per hour. With an air replacement of 1,200 cu. ft. per person per hour,[3] the removal rate (K) = 1,200/200 or 6 overturns per hour. The equilibrium (C/K) will be 0.0025/6 or 4.2 volumes of $CO_2$ per 10,000 volumes of air. With an outside concentration of between 3 and 4 volumes per 10,000 the inside concentration would lie between 7 and 8 volumes. "Pettenkofer, in 1858, proposed 10 volumes of carbon dioxide in 10,000 volumes of air as a limit for inhabited rooms. DeChaumont (1875) found that an unpleasant odor became perceptible in air containing 6 volumes of carbon dioxide in 10,000, and fixed this as a limit, which for many years was accepted by sanitarians." [2]

with the spread of respiratory infections, when the closing of doors, windows, or other natural vents confines the air commonly breathed by many persons, natural ventilation rates fall below 10 overturns per hour. To double air replacements, during cold weather, by mechanical or window ventilation raises practical difficulties, and has led to no conspicuous decline in respiratory diseases. With the opening of windows in the spring such infections consistently decline, with ventilation rates approaching 100 overturns per hour. Whether equivalent bacterial ventilation by air disinfection during the winter can accomplish similar hygienic results is an important problem in sanitary science.

An example of the solution of a general problem of sanitary ventilation by means of air disinfection, through experimental methods applying the bacteriologic procedure, is provided in the study and design of isolation cubicles in which ultra-violet light screens replace solid partitions or in which there is dropped a curtain of light continuous with an irradiated reservoir or "ceiling" above the eye level into which any solid cubicle partitions project.[4] Such cubicles, the experimental units of which were built and tested in the Henry Phipps Institute, Philadelphia, are now in routine use in the new building of the Cradle Society, Evanston, Ill. (Figure I). Sanitary ventilation tests upon the bacterial tightness of the experimental cubicles indicated: (1) in Type A cubicles (i.e., with solid partitions between cubicles, ultra-violet light curtains between cubicles and corridor), 99.6 per cent of the test organisms were removed in passing from the corridor to the cubicle, 98.9 per cent in passing from the cubicle to the corridor; (2) in Type B cubicles (i.e., where partitions between cubicles also were replaced with a curtain of ultra-violet light), 99.7 per cent of the test organisms were removed in passing from cubicle to cubicle. Tests upon the cubicles in the completed building, under actual operating conditions, have exceeded the results in the experimental unit.

Trial installations of light barriers have also been designed for the Children's Hospital, Philadelphia, and the Infants' and Children's Hospital, Boston, and such cubicle isolation would seem generally applicable to hospital use.

### BACTERIOLOGIC FACTORS

*Methods*—The equilibrium between the infection rate and the ventilation rate of the air of our habitations varies with a multitude of factors such as season, weather, variations in activity from day to day, hour to hour, or even minute to minute. The statistical constants which define these variable characteristics depend upon the analysis of numerous samples and, since air is a rarefied medium, upon large volumes. Examination of so changeable a medium requires an instrument adaptable to extensive field service. Simplicity and directness in technic are practical prerequisites both of economy and accuracy in any widespread sanitary survey.

It goes without saying that a method must be determinate, that with each condition a definite result is obtained, and that these results under uniform conditions are reproducible within the normal variation of the conditions themselves. It is a matter of convenience that the results be quantitatively proportionate to variations in conditions, or bear some simple functional relationship. "Absolute bacterial densities" are mere abstractions useful only in interpretation, and never delivered by bacteriologic technics.[5]

The numbers and kinds of organisms recovered from an air sample also depend upon the conditions of culture. An instrument must be flexible enough to permit the use of various culture

media. Direct collection on the culture medium may be desirable with sensitive parasitic organisms which quickly perish in the air. Organisms growing readily at blood temperature have been found in sanitary water analysis to be more indicative of pollution than those growing at room temperature, and the same principle holds in sanitary air analysis.[5] Whereas intestinal organisms are of primary concern in drinking water, nasopharyngeal organisms have significance in the air we breathe. Whereas gas formation in lactose broth is characteristic of intestinal contamination, green-producing streptococci (on blood agar) typify nasopharyngeal contamination. While special technic may be required in the search for pathogens or in special problems, the most serviceable method for general sanitary air analysis uses blood agar incubated at body temperature.

*Results*—Results of some two thousand air samples collected and analyzed by the Wells technic [6] are summarized in Table I. About one-third of these samples were analyzed in the authors' laboratories, with the assistance of several collaborators acknowledged in reporting the various studies. The remaining two-thirds of the samples were collected by the WPA Air Pollution Survey of the Department of Health of New York City,[7] and are indicated in the table by a dagger.

The textile mill samples represent atmospheres during a period of economic depression rather than the busy activity of better times. The average count given for Mental Hospital A does not give a complete picture for it averages the highest counts obtained under actual living conditions with lower counts which obscure this fact. The high streptococcus counts, however, may reflect the dissemination of respiratory organisms associated with the epidemic of pneumonia during which the samples were taken. The theater tests may also seem unnaturally low, and in the case of the Boston results we know the samples were taken between the warm and cold weather when the ventilating system was operating at its full capacity to exhaust the heat generated within the theater. In the results of subway samples as reported, there is nothing to indicate the jam during rush hours, nor does the report specify the conditions under which the samples were taken.

No pretense of precision can, therefore, be implied in this summary because standardization of collection and of isolation technics has not yet been perfected. Blurring due to imperfect technic may account for the want of contrast between some of the categories as compared to the clear definition observed among other categories. Want of technical skill in many of these laboratory analyses cannot be denied, any more than can perfect analysis compensate the failure of collections to represent truly their assumed classification—a more serious matter.

## SANITARY INTERPRETATION

In spite of these imperfections, however, the categories exhibit significant differences which serve the primary purpose of this paper. The difference between the counts of indoor and outdoor air is outstanding. Most samples classed as "indoor air" were taken during the colder months when "indoor air" was "confined air." The mill samples, though collected during the summer, represent air confined in order to regulate the humidity.

*Exclusion of Polluted Atmospheres*—Particularly in hospitals, where pathogenic sources are known to exist; may high total count signify increased hazard of infection. The provision of independent air supplies in special wards or rooms (as the premature ward of the Infants' Hospital in Boston)[8, 9] where asepsis is a vital consideration

TABLE I

*Sanitary Analyses of Air Supplies of Various Human Aggregations*

| | Number of Samples | Average Number of Colonies per Sample * | |
|---|---|---|---|
| | | Total | Alpha Streptococci |
| *Outdoor Air* | | | |
| Boston, Longwood | 72 | 16 | 0.12 |
| Philadelphia, downtown | 23 | 50 | 0.0 |
| New York, streets † | 143 | 112 | 0.45 |
| New York, Central Park † | 13 | 30 | 0.3 |
| Outside various textile mills | 14 | 46 | 0.0 |
| *Indoor Air* | | | |
| I. Experimental | | | |
| Quiet | 21 | 20 | 0.0 |
| Sneezing | 14 | 3,090 | 2,200.0 |
| Empty after sneezing | 4 | 1,440 | 920.0 |
| Using handkerchiefs while sneezing | 7 | 66 | 1.0 |
| II. Hospitals | | | |
| Infants' and children's wards | 160 | 496 | 0.8 |
| Premature ward, separately air conditioned | 26 | 20 | 0.0 |
| Chapple incubator, separately air conditioned | 92 | 18 | 0.0 |
| Miscellaneous wards | 13 | 247 | 2.9 |
| Operating rooms | | | |
| During operations | 6 | 450 | ... |
| Between operations | 7 | 55 | ... |
| Children's out-clinics | 28 | 728 | 13.3 |
| III. Institutions | | | |
| Mental Hospital A, all wards | 42 | 1,977 | 21.0 |
| Mental Hospital B, senile ward | | | |
| Without ultra-violet lights | 9 | 2,938 | 7.8 |
| With ultra-violet lights | 7 | 468 | 1.9 |
| IV. Schools | | | |
| Public, New York † | 707 | 296 | 1.8 |
| Public, Watertown (Boston) | 27 | 183 | 8.2 |
| Private, Philadelphia | 50 | 151 | 1.1 |
| College laboratories and lecture rooms | 22 | 106 | 1.4 |
| V. Assemblies | | | |
| Theater, air conditioned, Boston | 22 | 56 | 1.2 |
| Theaters, New York † | 253 | 72 | 0.3 |
| VI. Industrial | | | |
| Textile mills | | | |
| Dusty (carding, etc.) | 17 | 2,425 | 0.0 |
| Settled (spinning, etc.) | 17 | 261 | 0.0 |
| Humidified (weaving, etc.) | 21 | 275 | 0.0 |
| VII. Transportation | | | |
| Railway cars, air conditioned | | | |
| Without ultra-violet lights | 16 | 440 | 4.3 |
| With ultra-violet lights | 9 | 127 | 0.5 |
| Subway cars, New York † | 290 | 192 | 0.85 |

* The samples were approximately 10 cu. ft., but the accuracy of sampling and isolation by various workers does not warrant more precise analysis.

† These figures are computed from Pincus and Stern, *A.J.P.H.*, 27:321, 1937.

can be justified by the bacterial purity indicated by the tests. A study of the sanitary ventilation of Chapple infant incubators [10] supplied with clean outside air clearly shows the sanitary superiority of the air within the incubators over that of the wards in which they were placed.

*Qualitative Differentiation by State of Suspension*—Interpreted in conjunction with other observations much valuable information upon the quality of the contamination may sometimes be derived from bacterial counts. In the study of textile mill atmospheres [11] the ratio of bacterial concentration as determined by the centrifuge to plate settling count proved of great value in distinguishing between bacterial contamination derived from dusty operations and that contributed by humidification with polluted water. The differentiation of contamination derived from such widely different sources is necessary to a proper hygienic evaluation of the bacterial content of the atmospheres.

*Settling and Sedimentation*—Quite apart from such qualitative sanitary distinction the settling rate of bacteria-laden particles as determined by the ratio of plate count to that obtained by the centrifuge provides the key for interpreting the flight range of air-borne infection in space and time. Sedimentation in still rooms is an important factor in removing dust from the air.[12] The accumulation of settled infected dust [13] may, however, provide a dangerous source of reinfection. In operating rooms, preparations just preceding an operation may stir up accumulations, deposited over a long quiescent period between use and concentrate infection from distant parts of a hospital.

*Particle Size and Purification*—The coefficient of fineness, derivable from settling velocity,[11] may be a factor in the efficiency of purification devices which depends upon the physical characteristics of the particles. Such distinction between bacteria introduced into air by evaporation of salivary droplets and bacteria raised as dust by processes of attrition may be of vital importance in the hygienic interpretation of bacterial tubes. This is well illustrated in efficiency tests of a railway car installation of ultra-violet lights which showed a much higher effectiveness against nasopharyngeal organisms than against the wild varieties enclosed in dust raised by activity within the car.

## INDICES OF NASOPHARYNGEAL CONTAMINATION

The hygienic significance of breathing microörganisms fresh from the respiratory passages of others cannot be ignored. The numbers of streptococci characteristic of the nasopharynx indicate a hazard of respiratory infection and have a sanitary significance comparable with the presence of *Escherichia coli* in drinking water.[14] Examination of averages in Table I shows how these numbers vary with the condition of occupancy.

*Specific Infectivity*—Fluctuations dependent upon sneezing are indicated in experiments from which it is estimated that several thousand nasopharyngeal streptococci per sneeze are contributed to the atmosphere. The sneeze thus almost seems to be a provision of nature for the survival of nasopharyngeal parasites. Even where the manifestations of a disease do not provide for the wide auto-dissemination of the infection through air it has been observed that an outbreak of colds will be followed by the rapid spread of contagion.[15, 30] Sneezing induced by pollens might conceivably facilitate the spread of nasopharyngeal infection, and has indeed been suggested as a means by which the unseasonable spread of poliomyelitis is aided.[16]

These experimental results are borne

out by the field observations of Huddleston and Hull [17]:

> During February, 1919, there existed in the Army of Occupation what amounted to an epidemic of severe "colds" with extremely bad coughs and sore throats. Pneumonia cases were numerous. The first experiment was conducted on February 23. . . .
>
> It will be seen that in one minute an average of 82 organisms settled on the plates, and in five minutes, 151 organisms. . . .
>
> In picking colonies indiscriminately from the incubated plates four type IV pneumococci were found, and many hemolytic and nonhemolytic streptococci, with numerous staphylococci and Gram-negative and Gram-positive diplococci. . . .
>
> Eight days later (March 3), the experiment was repeated. . . .
>
> By the first of March the epidemic had practically cleared up. . . .
>
> The details of operation were identical in every particular—the same medium being used and the same methods. On the plates exposed 1 minute and 5 minutes the organisms found were extremely few in number. On the plates exposed 10 minutes an average of 16 colonies was counted. Among these, molds and staphylococci predominated; no pneumococci were found; 16 per cent of the total number of colonies present were streptococci, which showed partial but not complete hemolysis (alpha type).
>
> This great reduction from 82 organisms in 1 minute to 16 organisms in 10 minutes, which settled on the plates directly corresponded to the falling off of the epidemic. In either case, however, a man sitting through a performance of 1½ to 2 hours would inhale enough pathogenic organisms to give him any respiratory disease which might prevail among those sitting about him, provided he did not possess some natural or acquired resistance.
>
> The prevailing organism present in the respiratory passages of men admitted to the hospital at this time was *Streptococcus hemolyticus*.

*Sanitary Indices of Pollution Load*—The impression gained from inspection of Table I that the numbers of alpha streptococci in the atmospheres we breathe conform in a general way to the density of occupation and the degree of air confinement, is strengthened by a more detailed analysis of the New York figures.[18] Thus in reporting on the 6 schools selected in the New York study, the authors state:

> Schools numbers 1 to 3 have higher average numbers of streptococci per cu. ft. of air for all samples and for positive samples, as well as a greater percentage of positive samples, than do schools 4 to 6.
>
> Schools 1 and 2 are two of the oldest in the city and are in the lower east side. They are of definitely inferior construction, contain small rooms, and are difficult to keep clean, number 1 being the poorer of the two. It may also be of interest that the children are of the lowest economic group in the city, and come from a health area which shows a high incidence of reportable communicable disease. Schools 5 and 6, the two high schools in the group, are located in the upper middle west side. While of more modern construction than the first two schools they cannot be called new. They are of more suitable design than the former, however, since they have large rooms, large windows, and high ceilings.

With respect to degree of occupancy they state:

> The values for the average number of streptococci per positive sample for all schools indicate that occupied assembly rooms had most alpha streptococci, followed by occupied classrooms, corridors, just vacated classrooms, vacant assembly rooms, and vacant classrooms in the order named.

Table II likewise shows a relationship between passenger load of a railway car and the numbers of alpha streptococci present in the air. The ratio of streptococci count to passenger load for every moment in time obviously is not constant, but varies with activity of the passengers contributing to the atmosphere.

Hygienic interpretation of these results in the absence of extensive epidemiologic correlation can be based only upon general sanitary principles gained primarily from long experience with water supplies. The ingestion of intestinal organisms indicated by the presence of *Escherichia coli* in one-tenth of the volume of water consumed per 24 hours per person approximates a limit of safety set by the U. S. Treasury

TABLE II

*Relation Between Passenger Load and Bacterial Content of Air of Railway Car*

*(With and without ultra-violet light in air-conditioner)*

| *Tube Number* | *Sampling Time (in Minutes)* | *Number of Passengers* | *Total Bacteria* | *Alpha Streptococci* |
|---|---|---|---|---|
| | | *Ultra-Violet Lights Off* | | |
| 1 | 20 | 65 | 209 | 0 |
| 2 | 10 | .. | 1,022 | 9 plus |
| 3 | 20 | 69 | 1,324 | 5 plus |
| 4 | 10 | .. | 466 | 8 plus |
| 5 | 20 | 82 | 418 | 15 plus |
| 6 | 10 | .. | 1,324 | 7 plus |
| 7 | 20 | 75 | 860 | 23 |
| 8 | 10 | .. | 372 | 4 |
| 9 | 20 | 52 | 929 | 5 |
| 10 | 10 | .. | 209 | 2 |
| 11 | 20 | 48 | 372 | 6 |
| 12 | 10 | .. | 442 | 1 |
| 13 | 20 | 30 | 1,069 | 3 |
| 14 | 10 | 16 | 325 | 2 |
| 15 | 20 | 1 | 232 | 0 |
| 16 | 10 | 6 | 232 | 1 |
| | | *Ultra-Violet Lights On* | | |
| 17 | 20 | 15 | 349 | 2 |
| 18 | 20 | 28 | 256 | 3 |
| 19 | 20 | 39 | 232 | 0 |
| 20 | 20 | .. | 139 | 0 |
| 21 | 20 | 43 | 302 | 0 |
| 22 | 20 | .. | 302 | 1 |
| 23 | 20 | 48 | 232 | 0 |
| 24 | 20 | 55 | 186 | 0 |
| 25 | 20 | 55 | 279 | 1 |

Standard [19] for drinking water. The inhalation of more than 10 times as many respiratory organisms in the same period is indicated by the presence of three alpha streptococci per sample of 10 cu. ft.

### EPIDEMIOLOGIC FACTORS

Sound sanitary principles appropriate to ingested infection from drinking water cannot be applied arbitrarily to an inhalation theory of the spread of respiratory disease without confirmation of the underlying assumptions. They may, however, lead to more fruitful hypotheses than the smug logic familiar to the early advocates of pure water that the air breathed "all one's life" cannot help to explain the universality of respiratory infection. Where the *droplet* theory has led only to a hopeless attitude toward the sanitary control of respiratory disease, a theory of airborne infection, based upon the wide dissemination of *droplet nuclei* through occupied spaces,[20] promises such sanitary methods for building up community resistance against the spread of this important class of infections as have proved so successful in controlling spread of insect-borne and intestinal disease.

Topley and Wilson [21] clearly indiccate the potentialities of increasing community resistance by control of the sanitary factors involved in the spread of infection.

The herd, like each of its members, has a characteristic structure; and this structure, from our present point of view, includes

not only the hosts belonging to the herd species, and their spatial relationships to one another, but the presence and distribution of alternative animal hosts and possible insect vectors of infection, as well as all those environmental factors that favour or inhibit the spread of infection from host to host. This herd structure, apart altogether from the susceptibility or resistance of the individual hosts, may play a decisive part in the immunity of the herd as such. A herd may be immune to a particular disease—in the logical sense that it will resist the introduction of infection from without—although each of its members is fully susceptible, and would fall an easy victim if he strayed to a herd with a structure that allowed an endemic prevalence of the disease in question. In this sense the English herd is immune to plague; because the association of man, the rat and the flea is not now of a kind to allow spread along natural routes. It is probably immune to cholera, as the result of an adequate system of water purification. It is not—nor does it seem likely to become—immune to any of those diseases that are spread by droplet infection. It would take us altogether beyond our present scope to consider the known or problematical effects on herd resistance of such changes in environmental conditions; but we may at least note that many of the most striking successes of preventive medicine have been attained by altering herd structure without inducing any increased resistance in its individual members. By attacking insect vectors of infection, such as the mosquito, by preventing the frequent passage of bacteria from one person's intestine to another person's mouth by way of water and food, and by a general improvement in environmental conditions, we have succeeded in eliminating, or reducing to negligible proportions, diseases that formerly took a heavy toll of lives, and still take that toll in areas where such measures are not applied.

Substitution of the words "community resistance" for "herd immunity" would better contrast sanitary resistance to the spread of infection through a community with that conferred upon a herd by the specific immunization of a portion of its members.

If bacteriologic interpretations are corroborated by epidemiologic experience, sanitary ventilation, based upon a theory of air-borne infection by droplet nuclei, promises to become an important factor in public health.

### SPREAD OF INFECTION THROUGH AGGREGATIONS

The hypothesis that contagion may be spread through the common occupancy of semi-confined atmospheres defines an epidemiologic pattern in terms of sanitary ventilation. Though sanitary and epidemiologic indices of ventilation have never been specifically correlated, extensive data on the spread of respiratory infection through various human aggregations sharing common atmospheres have accumulated. General correlation between types of ventilation characterizing these types of aggregation and epidemiologic indices derived from these studies reveals the consistency between our interpretation of the bacteriologic measure of air infection and the spread of respiratory disease.

*Continuous Aggregations*—The spread of disease through semi-confined atmospheres is not always an obvious phenomenon. Since the individual normally shuttles from aggregation to aggregation, it is generally impossible to distinguish the atmosphere within which an infection is contracted. Even where respiratory infections are known to be contracted within a continuous aggregation of individuals, only under special circumstances can sources other than air be entirely eliminated. In a careful study of the spread of infection in the Infants' Hospital, Boston, McKhann and his associates [22] report 134 acute respiratory infections developing among 1,455 admissions during 1935 and 1936. Converted on the basis of the time of residence, this attack rate becomes an annual rate corresponding to *epidemic* spread of water-borne intestinal infection (more than 100,000 cases per annum per 100,000 population at risk). In a further analysis of these data,[9] they conclude that contact infection,

droplet infection, and droplet nuclei infection are all operative within the hospital, and that a clear distinction must be made in the proportion of infections attributable to each mode of spread in an appraisal of methods of control. He distinguishes the principles of control applicable to each mode of spread, and will later report upon experimental control measures. He is extending to cubicle isolation the principle of an ultra-violet light barrier against droplet nuclei infection, inaugurated nearly 2 years ago in a corridor. He also remarks upon the striking reduction of respiratory infections in the premature ward,[8] correlative with a demonstrated reduction in bacterial contamination, consequent upon the installation of an independent outside air supply (see Table I).

By means of the newer laboratory technics which permit cross-infections to be traced as both clinical cases and subclinical infections, we are coming to realize how much more numerous they are than had been supposed. Clinical cases of certain nasopharyngeal infections may constitute, according to advanced work, particularly in England, mere outcroppings of epidemic strata of subclinical infection which can be located by the newer technics of bacterial typing.[23] By such procedures the latent image of the mode of spread of nasopharyngeal infection, manifest in such diseases as measles and influenza and deducible from epidemiologic studies of age incidence and immunity tests,[24] may be developed.

*Intermittent Aggregations* — The spread of infection through intermittent aggregations may often be traced by the characteristics of the disease. The incubation period in some of the common infectious diseases of childhood, where lasting immunity is conferred, links primary with secondary cases. Every "contagious" case is secondary in some one aggregation, though it may or may not be a primary to other cases in that or other aggregations. The number of secondaries thus exceeds the number of primaries except in the limiting case of perfect endemicity where the number of secondaries equals the number of primaries and there is no change in the rate of incidence. The sharper the epidemic, the more do secondaries exceed the primaries.

The spread of contagion through various types of aggregations describes the progress of an epidemic through the community. It is evident from Wilson's intensive study [25] of the epidemiology of measles in Providence that the 6 to 7 year old group of children provides the stratum of the population in which lies the reservoir of measles from which family primaries are drawn. This is true whether a younger or an older child is the primary in the family. Thus an elder child passing through this stratum without becoming a family primary is more likely to become later a secondary to a younger primary drawn from this stratum. The ratios of secondaries to primaries in the aggregations constituting this reservoir may vary independently from the ratios of secondaries to primaries in the family aggregations. Epidemic surges, therefore, arise from the interlocking of these various aggregations forming the knots in the vast network of contagion.

The family has been a favorite aggregation for the study of these phenomena:

> One of the most characteristic features in the epidemiology of the common acute communicable diseases is the grouping of cases in time and space; and this is especially apt to be noted in the group which constitutes a household, people in close contact with each other, sharing a common environment, mostly of close kinship, and usually under the eye of at least one medical or lay observer whose observation encompasses the whole group.

Thus did Frost [26] introduce a discussion of "Familial Aggregations of In-

fectious Diseases" based upon Chapin's classic work on secondary attack rates. In 1925 Chapin showed that 88.3 per cent of presumably susceptible children of ages 1 to 5 contracted measles when a case was introduced into the home.[27] He concluded further:

> Scarlet fever, consequently, is in reality much more contagious than the diagram would indicate, for the number of non-immunes is less than formerly assumed. It therefore seems probable that the greater contagiousness of measles, as suggested by Diagram III, is to a considerable extent apparent only. . . . Indeed, it is possible that diphtheria might be proved to be not so very much less contagious than measles. . . . We have no data in Providence bearing on the contagiousness of smallpox, but certain facts, from other places indicate that it approaches measles in this respect.

Dyer[28] quotes Rist and Weiss and Zingher and others who—

> have noted the tendency of children of the same family to give similar reactions to the Schick test, and that in case of variations, as a rule, the younger children have shown positive reactions and the older negative, the reverse of this being very rare.

In response to the Dick test, Dyer's own results among 263 families of two or more children showed that: (1) in 151 instances all were Dick positive; (2) in 30 instances all were Dick negative; (3) in 41 instances younger children were positive, older were negative; (4) in 25 instances younger children were negative and older children were positive; (5) in 16 instances in family groups of three or more children, other combinations were shown. That is to say, in only 15 per cent of the 263 families was a younger child immune and an older child susceptible.

Similar phenomena with respect to tuberculosis among families is reported by Opie and McPhedran[29]:

> When latent tuberculosis is taken into consideration, tuberculosis exhibits the characters of a contagious disease and affects all children of households within which some member, suffering with tuberculosis, scatters tubercle bacilli.

As regards the spread of homologous types of pneumococci among family contacts, the Advisory Committee on Prevention of Pneumonia Mortality state[30]:

> The findings obtained in a few studies of a small number of families suggest that when pneumonia due to one of the more virulent types, for instance Type I, occurs in an individual, about 20 per cent of the other members of the patient's family are also carrying that same type of organism in their noses or throats. Where acute upper respiratory infections, such as colds, are prevalent among the family contacts, the incidence of homologous type carriers may approach 70 or 80 per cent.

The interesting epidemiologic fact[31] that the average age at which first-born children contract clinical poliomyelitis is greater than second-born, second-born greater than third, etc., suggests simultaneity of infection, clinical or subclinical, within the family. The family pattern of subclinical infection would, therefore, be similar to the family pattern of clinical infection in the case of measles. The epidemiologic study of immunity by birth order in a family gives such distribution of age incidence as would follow the assumption that the introduction of an infection into a family leaves the exposed members of the family immune if they do not contract a clinical case of disease.

*Time of Exposure*—It appears from such experience that a susceptible child breathing the air in a home harboring a contagious case seldom escapes infection, either manifest or latent. Here the time element in exposure (early observed by Denny[32]) characterizes airborne infection. Both the case and the victim continuously breathe the same atmosphere for extended periods of time. In schools, on the other hand, the time of exposure is markedly reduced by the prompt removal of detected cases. Boarding schools in this respect are intermediate between day schools and homes. In a very thorough

FIGURE 1—Sanitary ventilation by means of bactericidal radiation in new building of the Cradle, Evanston, Ill. Ultra-violet light barriers separate cubicles from corridor. In right tier of cubicles, ultra-violet light curtains also replace alternate solid partitions.

FIGURE 11—Droplet nuclei (contrasted with Flügge droplets) photographed by the Tyndall effect. Upper left, sneezing; upper right, pronouncing the letter "p"; lower left and right, pronouncing the letter "t." (Taken [illegible] Wasserstoffgas.)

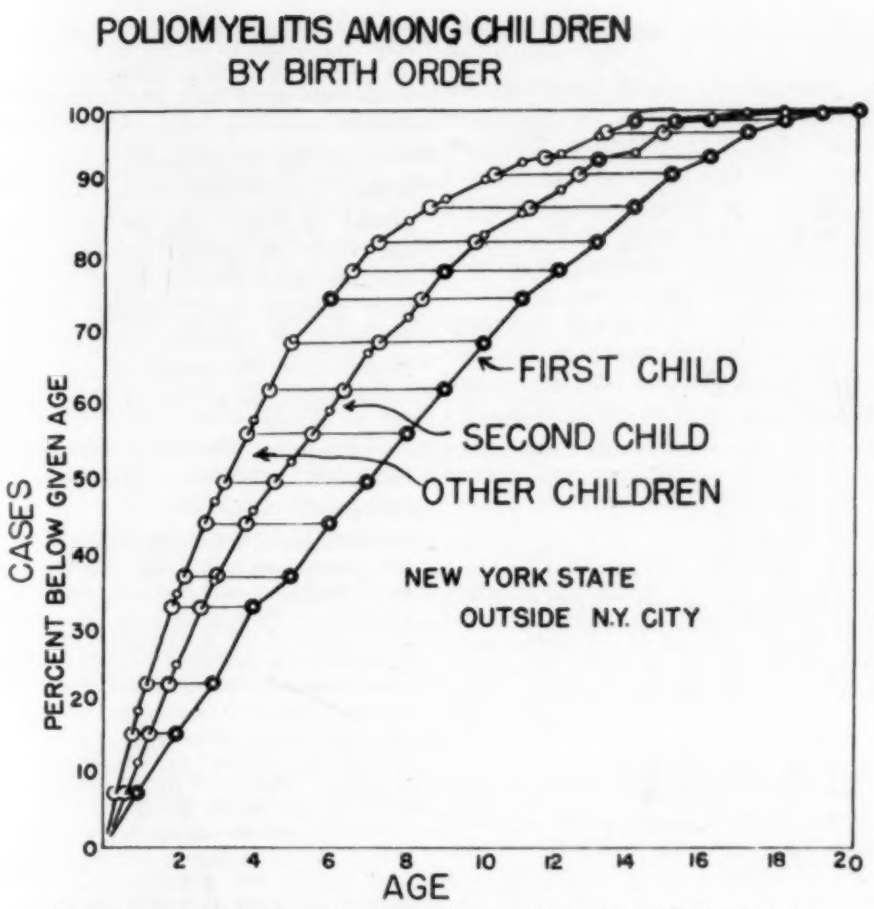


FIGURE III—Age incidence of poliomyelitis by birth order. New York State (exclusive of New York City), 1926–1930. (Data obtained through the courtesy of Dr. E. S. Godfrey.)

study of "Epidemics in Schools" recently issued by the Medical Research Council of Great Britain (Special Report Series No. 227 [33]) the records over 5 years show an average of 14.2 cases for each contagion * introduced into 26 boarding schools and 3.3 cases for each contagion introduced into 2 day schools. The schools were broadly comparable in size and age-distribution and the probability that these figures reflect differences in exposure-time rather than differences in numbers or immunity-composition of the subjects is borne out by the familiar studies of Dudley [34] on the different attack rates of day and boarding pupils.

*Intensity of Infection*—Data on the intensity of infection so clearly emphasized by Glover [15] are also provided in the same study. An average of 17.2 cases for each contagion introduced into 17 boarding schools for boys, as against an average of 9.1 cases per introduced contagion in 9 girls' boarding schools (in spite of greater degree of reported immunity among the boys) may indicate the greater congestion in

* The word "contagion" is here used in a restricted sense. It refers to the common childhood contagions: measles, German measles, mumps, chicken pox, whooping cough, scarlet fever and diphtheria.

boys' dormitories than in the girls' houses. In the boys' day school, on the other hand, where conditions for the spread of contagion are more comparable, 2.8 cases as against 3.8 cases in the girls' day school per introduced contagion, probably also indicate greater immunity among the boys.

Could it be that differences in climate and method of ventilating homes in England and New England may help to explain the differences in the secondary attack rates in St. Pancras and in Providence, as observed by Wilson [25]:

> Moreover, Greenwood's data taken from Stocks show secondary attack rates of 25 to 35 per cent with all children under 10 years of age left in whether immune or not and of 45 to 50 per cent with the immunes (those who had had measles) rejected, whereas we find in Providence secondary attack rates on susceptibles under 10 running 75 to 80 per cent, and on all children under 10 from 60 to 65 per cent. Apparently, then, measles is far less infectious under conditions of family life in St. Pancras than in Providence.

Could the conditions which account for one escape in a family so favor other susceptibles as to depress the secondary attack rate as found by Wilson [25]:

> If next we look to the single primary families which have one specified susceptible escape, we find the secondary attack rate on the other susceptible to be $55.6 \pm 4.6$, and thus the presence of an escape lowers the secondary attack rate more than the presence of an immune.

Could the seasonal difference in secondary attack rates in Detroit, as reported by Top,[35] also be explained on the basis of greater confinement of children in air more confined from January through April, causing a greater intensity of infection during those months over the preceding and following months, as shown in Table III.

TABLE III

(Detroit, 1935, Top)

*Attack Rates among Susceptible Contacts by Age and Month*

| *Month* | *Number Contacts* | *Number Cases* | *Attack Rates* |
|---|---|---|---|
| January | 38 | 33 | 86.8 |
| February | 136 | 120 | 88.2 |
| March | 589 | 511 | 86.8 |
| April | 620 | 532 | 85.8 |
| May | 196 | 156 | 79.6 |
| June | 45 | 26 | 57.8 |
| July | 6 | .. | (0.0) |
| August | .. | .. | (...) |
| September | 3 | 2 | (66.7) |
| Totals | 1,633 | 1,380 | 84.6 |

What interrupted the "seasonally interrupted" epidemic in Providence, also referred to by Wilson [25]:

> The course of measles in Providence 1929–1934 was characterized by a low incidence in all years but 1931 and 1932 and a major epidemic in those years. . . . The course in 1931 consisted of a moderate epidemic in the late spring falling to a score of cases in September and a sharp rise to epidemic proportions. For this reason we consider that the behavior of measles in 1931–1932 may properly be characterized as a major epidemic seasonally interrupted rather than as two epidemics, one in the late spring of 1931 followed by another in the fall of 1931 and winter of 1932. Hence we shall speak of 1931 as the first and 1932 as the second part of the great 1931–1932 epidemic which contained about six-sevenths of all the measles in the 6 year period 1929–1934. The ratio of secondary to primary cases changes from year to year by more than can be attributed to chance; it is quite high in 1931 and decidedly low in 1932. The ratio of primaries to families also changes being apparently low in the years in which there is little measles—the difference between the figures for 1931 and for 1930 being not significant.

*Multiple Exposures*—Such a prevalence of disease as subjects a case to multiple infections in different aggregations complicates the determination of the degree of exposure in any one aggregation. Incidence within an aggregation becomes more truly a measure of susceptibility than of degree of exposure to infection for such diseases as the common cold, where lasting immun-

ity is not conferred, where several attacks per person per season may occur, where adults as well as children harbor the infection. Thus Wilder [36] observed that, in the Germantown Friends School, the epidemiologic pattern of upper respiratory infections differs from the pattern of childhood contagions. The incidence of colds is remarkably uniform from year to year, and constant for classes and groups of individuals. Our own analysis of Wilder's data convinces us that school exposure does not ordinarily determine incidence of colds within day schools: absences from colds on Wednesday, Thursday, and Friday account for no more than their proportionate share of the weekly incidence. Assuming broad infection spread (i.e., more than one infection per cold), prevention of colds would depend upon the prevention of multiple infections, for not until the last remaining infection was prevented would a cold be avoided. Studies of methods for the prevention of colds will require isolated aggregations, unexposed to a variety of outside sources, where spread within the aggregation can be measured.

## DIFFERENTIATION OF EPIDEMIOLOGIC PATTERNS

The demonstration of an epidemiologic pattern of spread of contagion through aggregations sharing common atmospheres, even though consistent with a demonstrated mechanism for interchange of nasopharyngeal organisms in breathing the common air supply, does not of itself necessarily demonstrate air-borne disease. High correlation between the common occupancy of semi-enclosed atmospheres with other opportunities for infection might lead to similar phenomena.

Close association within aggregations sharing a common air supply also facilitates spread of infection by Flügge droplets and contact. Separation of these modes of spread can be made only on the basis of more refined analysis of the original data than is possible with records studied and reported through the medium of the droplet or contact theories. The degree of proximity in time and space required by these hypotheses will not, however, explain many well established examples of the spread of contagion.

*Exclusion of other Modes of Spread* —Thus in the classic outbreak of psittacosis in the Hygienic Laboratory, reported by McCoy,[37] both droplets and contact could be rigidly eliminated. Stimson [38] states:

> During the course of the experiments, which had been undertaken with what appeared to be ample precautions, an outbreak occurred among the personnel at the National Institute of Health, involving 11 persons, 1 of whom died. This would seem to indicate an almost incredible diffusibility of the infection through the air, since some of the victims had not been nearer to the rooms in which the animals were kept behind moist curtains, and with troughs of disinfectant at the doorways, than to pass to and occupy rooms in distant parts of the large buildings. This has led to the assumption that the virus may be spread by the "powder down" thrown off by parrots, which seems to have a diffusibility comparable to the pollens.

Seldom in epidemiology can the factors of droplets and contact be so completely eliminated. In experimental work on animals, however, these variables can be controlled. Thus Dunkin and Laidlaw,[39] in reporting on the spread of dog distempter through ferret and dog aggregations in which these factors were carefully excluded, state:

> Control dogs cannot be kept free from disease in the experimental house, though kept in separate cubicles and the fullest antiseptic precautions maintained by the attendants to avoid carrying infection from one animal to the other. The dogs were not confined in Topley cages, and so the barrier against spread of infection in their case was less perfect; but we are convinced that aerial spread can and does occur in closed buildings, and we have now abandoned experimental work with dogs in confined spaces and work in the open air.

We pointed out that in the case of ferrets there was practically conclusive evidence of air spread of the virus of dog-distemper in confined spaces over short distances. Our experience with dogs is in entire harmony with this conclusion, as we found that it was impossible to keep a control dog in one cubicle of the experimental house when infected dogs inhabited the adjacent cubicles. We were compelled to abandon this method of experiment and substituted a system which is in large measure successful. It consists in keeping the experimental dogs in kennels and small runs scattered about the grounds around the laboratory buildings. Each kennel has a small run enclosed by fencing and wire netting, and is separate from its nearest neighbour by a distance of 15 to 20 yards. We thus rely on dilution by the external air to prevent the spread of infection from one cage kennel to its neighbour. The attendants who attend to the animals wear the rubber armour which has previously been described, and between each visit to a cage kennel have this armour washed down with lysol. All excreta and all food and drinking vessels are disinfected with lysol every day. The dogs are fed on boiled biscuit and boiled horse meat and bones.

Direct infection of the lung by intranasal instillation (under anesthesia) is now a recognized laboratory procedure. Infection through the respiratory tract by dust containing tubercle bacilli has been reported frequently and has become a routine procedure for experimentally infecting rabbits at the Henry Phipps Institute.[40] Inhalation experiments have also shown that animals can be experimentally infected by breathing air in a chamber which has been sprayed with pathogenic microörganisms.[41]

More recently we have devised a technic for infecting animals in air conditioned chambers supplied with air infected with "droplet nuclei" outside of the chamber. No objection can be raised to the conclusion that these were truly air-borne, for they had been carried in the air stream over long distances. The bacterial concentration of the air was quantitatively controlled, and a relationship demonstrated between the quantity of infection so breathed and the mortality of the animals. Elaboration of this equipment will permit exposures of large numbers of animals over long periods of time to small concentrations of infection and so imitate the conditions of ventilation in our habitations. Experimental ventilation will bridge the bacteriologic deductions in the first part of this paper with the epidemiologic observations considered in the second part.

*Determination of Pattern by Ecologic Factors*—Exclusion of other than one mode of spread is not necessary to distinguish an epidemic pattern. Plague in warm climates disseminated by rodents, insects, contact, and droplets may become suddenly transformed into a pneumonic or air-borne pattern better explained by droplet nuclei under conditions of crowding within enclosed spaces during cold weather. Thus Strong and Teague,[42] after showing experimentally that the period of infectivity of pneumonic plague coincides with the coughing phase of the disease in which the air becomes infected, show:

> . . . from the study of human lesions and those produced experimentally in animals it would appear that endemic plague pneumonia results from inhalation, the primary point of infection being the bronchi.[43]

They further state that

> there is a greater tendency for the disease to spread in cold climates than in warm ones.

In harmony with the above ideas, we find that the only great epidemic of pneumonic plague of modern times occurred in Manchuria during the winter of 1910 to 1911, when the atmospheric temperature was many degrees below zero Centigrade. The disease spread with amazing rapidity. Furthermore, although during the past fifteen years there have been millions of plague cases in India and 2 to 5 per cent of these have been cases of plague pneumonia, yet this form of the disease has not assumed epidemic proportions. The largest epidemic of pneumonic plague in India (1,400 deaths) occurred in Kashmir in northern India at an elevation of 1,524 meters above the sea level during very cold weather.[44]

Strong, in 1935,[45] summarizing his experiences, states:

> Thus it was shown that while the germ of primary pneumonic plague is essentially the same as the organism of bubonic plague (with the exception of exhibiting a uniformly great virulence throughout the epidemic), the portal of entry of the microörganism is different from that in bubonic plague; and that in an epidemic of primary pneumonic plague, rats and fleas play no part in the transmission of the disease, the infection occurring directly from man to man by the droplet method of infection in a somewhat similar manner as in influenza. Overcrowding of the inhabitants in midwinter in small huts (sometimes thirty to forty people in one room) with very little ventilation was an important factor in the spread of the disease in Manchuria.
>
> In the spread of respiratory diseases, the recent investigations of Wells and Stone (1934) upon air-borne infections are of interest, in which they point out the importance of dried infected droplet nuclei derived from droplets less than one-tenth of a millimeter in diameter.

*Velocity of Spread*—Perhaps the most characteristic feature of the air-borne pattern is the velocity of epidemic spread of infection,[46] implicit in the droplet nuclei hypothesis. The spread of influenza through army barracks during the World War could not, we believe, have been so swift as that described by Opie, Blake, Freeman, Small and Rivers[47] if it travelled by steps limited in space to the proximity demanded by the droplet or contact theory and separated in time by the necessary incubation period.

> The most striking feature of the epidemic was the extremely rapid spread of the infection throughout the camp. Starting September 22 in a regimental area situated in the extreme southwestern corner of the camp, the disease had within 4 days appeared throughout the camp proper, and 4 days later appeared in two outlying encampments, situated respectively 1 mile north and 3 miles east of the main camp.
>
> No single organization escaped the infection, and during the 30 days from September 20, 23.3 per cent of the total population of the camp suffered from the disease. The figures given herewith are based on a detailed study of 11,725 cases occurring between September 20 and October 14, and comprise practically the whole of the epidemic. . . .
>
> Infection with hemolytic streptococci may spread as an epidemic through the pneumonia wards of a hospital. A single patient with streptococcus pneumonia is a source of grave danger to every patient in the same ward. Superimposed infection with hemolytic streptococci increases the mortality of pneumonia so that it may reach from 50 to 100 per cent of all patients with pneumonia. . . .
>
> There seems little reason to doubt that the incidence of pneumonia and the death rate of that which occurs might be greatly diminished by preventing all overcrowding of new recruits in barracks and by providing hospital facilities in considerable excess of the routine demand.
>
> Hospital epidemics of streptococcus pneumonia will be prevented when medical officers have that dread of the disease—comparable to our dread of puerperal fever—which is inevitable when its characters are accurately understood.

*Transition from Contact to Air-borne Pattern*—In this sense measles may or may not assume an air-borne pattern. The School Epidemics Committee report[33] states:

> It is a remarkable fact that quite a high proportion of outbreaks of infectious disease did not spread at all. . . .
>
> It will be noted that on the average about 30 per cent of all outbreaks among the boys, and about 40 per cent among the girls, were thus curtailed (that is, limited to one case, though girls were more susceptible than boys). . . .
>
> When introduced into a school, measles may or may not spread, quite irrespective of the number of susceptibles in the population, but it is more likely than any other disease to assume epidemic proportions, at any rate among the boys. . . .
>
> We have other examples of measles gaining access to a school early in the term, hanging fire for a few weeks, and then causing a large epidemic.

A study of the figures in this report will reveal the fact that over one-half of the cases of measles resulted from less than one-fifth of the introductions of the contagion, and that over 90 per cent of the cases resulted from less than one-half of the introductions.

Some factor besides the virulence of the virus or the resistance of the host must be involved in these wide differences in the velocity of spread of a disease which is considered so highly contagious.

The transition from a contact to an air-borne pattern of spread following the introduction of independent means of dissemination of the virus through air is described by Stallybrass.[15]

> In mumps the author has noticed that the disease sometimes progresses slowly in a school until an outbreak of an epidemic catarrh causes much sneezing, coughing, and spluttering. The mumps epidemic now progresses rapidly. The sudden outbreak marks the transition from contagion to droplet infection and not the alteration of the virus. It has repeatedly been noticed that return cases of scarlet fever follow an attack of a cold in the infecting case; a cold not only increases the amount of mucus discharged into the outer world, but also produces sneezing and coughing; it may also determine a relapse of otorrhoea.

Although Stallybrass uses the words "contagion" and "droplet infection" in a sense differing from that used in this paper (showing, in fact, the confusion in terms applied to the mode of spread of nasopharyngeal infection), there can be little doubt that he recognizes a distinction between the contact and air-borne patterns.

## SUMMARY AND CONCLUSION

"Measurement of Sanitary Ventilation" described a method of determining the rate of *removal* of microörganisms from semi-confined atmospheres, with special reference to air disinfection by means of ultra-violet light. An example of the practical usefulness of this method is offered by an experimental study and design of isolation cubicles in which ultra-violet light screens replace solid partitions or where a curtain of light is dropped, continuous with an irradiated reservoir or "ceiling" above the eye level into which any solid cubicle partitions project.

The present paper considers methods of determining the rate of *addition* of microörganisms to semi-confined atmospheres in defining the hazards from air infection and means for the avoidance of such infection.

Sanitary interpretation of analyses of some two thousand samples of air supplied to various human aggregations reveals the consistency between deductions from a theory of air-borne infection, based upon bacteriologic experiments, and epidemiologic evidence of the spread of contagions through aggregations sharing a common air supply. Air-borne infection of animals exposed to quantitative dosage in experimental ventilation further reflects this consistency.

Some few outstanding examples are selected to illustrate an epidemic pattern, fogged by the droplet theory, but clear when viewed through the hypothesis of nuclei from the evaporated droplets. Such a pattern of air-borne spread by droplet nuclei accurately describes the epidemic spread of respiratory infection among individuals aggregated within atmospheres in some degree confined, and can be related to the familiar pattern of epidemic spread of intestinal infection through the medium of water, food, or milk.

Both intestinal and respiratory infection are undoubtedly spread *endemically* by intimate personal contact. The simultaneity or swiftness of *epidemic* spread of both, however, can be better explained by common source media. Each describes its own epidemic pattern true to the physical and biological factors which govern the respective media, just as the patterns of both differ from the pattern of insect spread of disease.

Discovery of the vehicles of transmission of ingested intestinal infection led to successful sanitary measures of control. Recognition of a vehicle of contagion may likewise suggest the means

of preventing epidemic respiratory infection.

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# Public Health Administration Program

TODAY public health administration is questioning every form of disease, physical and mental; its thought is not limited to the modest possibilities of the clinic, the classroom, or the health leaflet or poster; it demands complete medical service and plans widespread popular education in hygiene as a matter of course, but these activities have been reduced to minor rank in a larger and more significant program. Public health administration now aims to control all environmental factors which affect health. The stupendous task which it appears to have set for itself is not quite frankly avowed, but this task, as I apprehend it, is to define and to apply through social administration a physiologically sound standard of living. Public health administration proposes, in effect, a benevolent dictatorship in the name of health, thus applying in a drastic and wholly unexpected form, the familiar saying that the public health is a concern of government.—*S. S. Goldwater, M.D.*, at dedication exercises, Memorial Hospital, New York, June 14, 1939.

# Paratyphoid Fever in Massachusetts*

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A SUDDEN increase in paratyphoid fever occurred in Massachusetts in 1937. From a level of about 6 cases per year, the number reported rose to 267 (Table I). Even in the face of the previous low incidence, Massachusetts was one of the last states to continue the use of triple vaccine. In April, 1937, it was finally decided to omit both the paratyphoids but before monovalent vaccine went into distribution the sudden increase in paratyphoid B infections had been observed and it was decided for the time that a bivalent typhoid-paratyphoid B vaccine would be distributed.

The cases reported in 1937 fall readily into five groups. There were 4 food-borne outbreaks, and the remainder were sporadic cases widely scattered throughout the state.

## Outbreak I: Pastry-Borne

The first and largest outbreak began early in April, but was not recognized until late in the month. Beginning April 15, several positive and suggestive Widals were reported on specimens sent in from communities north of Boston. One or two cases seen by the district health officer did not appear to be typical typhoid fever. On April 22 a postmortem culture from a fatal case of supposed typhoid and a stool specimen from a case which had shown a suggestive Widal both showed the presence of paratyphoid B bacilli. All laboratory specimens submitted from the area were scrutinized immediately to discover whether they might not be from unrecognized cases of paratyphoid fever. Inquiries among physicians in the communities brought to light other cases of diarrhea and fever of unknown origin.

An attempt was made to find some common factor among the cases which

Table I

*Reported Cases of Paratyphoid in Massachusetts 1930–1938*

| Year | Cases of Paratyphoid A | Cases of Paratyphoid B |
|---|---|---|
| 1930 | 0 | 0 |
| 1931 | 1 | 5 |
| 1932 | 1* | 6 |
| 1933 | 0 | 10 |
| 1934 | 1 | 5 |
| 1935 | 0 | 5 |
| 1936 | 2 | 5 |
| 1937 | 1 | 267 |
| 1938 (9 mos.) | 0 | 66 |

* 4 cases not stated

* Read before the Epidemiology Section of the American Public Health Association at the Sixty-seventh Annual Meeting in Kansas City, Mo., October 26, 1938.

† The authors, the present and the former Director of the Division, are merely serving as spokesmen for the Division since all of the central office staff and most of the District Health Officers shared in the investigation. Special credit is due to the staff of the Bacteriological Laboratory under Miss E. A. Beckler who handled so creditably the large volume of specimens made necessary by the outbreaks. The department also acknowledges the splendid coöperation of the local boards of health in handling the problems which arose. Dr. Anderson is now Professor of Preventive Medicine and Public Health, University of Minnesota.

were discovered. They were living in widely separated communities. There had been no large gatherings at which all had been present. Water supplies and milk supplies were numerous. Many of the early cases were among children. This latter point was kept in mind when searching for other common vehicles which might be widely distributed throughout the area. It was found that some gave a history of having eaten jelly rolls. The source was looked up and it was noted that the baker also made cream puffs and a pastry which consisted of two pieces of chocolate cake held together by a thick marshmallow cream. Upon inquiry it was discovered that many of those ill had eaten these other pastries, especially the marshmallow cake. The baker was advised to stop the manufacture of the latter. He had already stopped making cream puffs on March 1.

In searching for the source of the infection all of the food handlers in the bakery were examined. It was discovered that the man who worked at the wrapping counter and occasionally helped with the filling of the pastry was excreting paratyphoid organisms in his stool. He gave no history of having been ill. After a few positive examinations the organisms disappeared from his stool. It was, therefore, impossible to determine whether he was the cause of the outbreak or whether he himself had picked up the bacilli from the bakery products. Examination of the raw materials which went into the products was undertaken and an organism belonging to the Salmonella group was discovered in the powdered egg. It was culturally and immunologically different from those isolated from the stools of patients.

The baker produced large quantities of these inexpensive pastries. They were sold by four delivery men who had routes covering a large number of the cities and towns in the northeastern part of the state (Table II).

TABLE II

*Outbreak 1: Pastry-borne*

*Distribution of Cases and Products of Bakery*

| *Community* | *Cases Para B* | *Number of Stores Supplied* | | | | |
|---|---|---|---|---|---|---|
| | | *Driver No. 1* | *Driver No. 2* | *Driver No. 3* | *Driver No. 4* | *Total Number* |
| Lynn | 25 | .. | .. | .. | 45 | 45 |
| Winchester | 23 | .. | .. | 1 | 4 | 5 |
| Lowell | 16 | 72 | .. | 66 | 4 | 142 |
| Woburn | 13 | .. | .. | 3 | 11 | 14 |
| Lawrence | 12 | .. | 82 | .. | .. | 82 |
| Wakefield | 9 | .. | .. | .. | 14 | 14 |
| Melrose | 7 | .. | .. | .. | 16 | 16 |
| Stoneham | 6 | .. | .. | .. | 3 | 3 |
| Methuen | 3 | .. | 5 | .. | .. | 5 |
| Reading | 3 | .. | .. | .. | 2 | 2 |
| Billerica | 3 | .. | .. | .. | 10 | 10 |
| Everett | 3 | .. | .. | .. | 10 | 10 |
| Saugus | 2 | .. | .. | .. | 9 | 9 |
| Somerville | 2 | .. | .. | 18 | .. | 18 |
| Medford | 2 | .. | .. | 10 | 6 | 16 |
| Burlington | 1 | .. | .. | 3 | .. | 3 |
| Dracut | 1 | 4 | .. | .. | .. | 4 |
| Malden | 1 | .. | .. | .. | 9 | 9 |
| Andover | 0 | .. | 1 | .. | .. | 1 |
| Cambridge | 0 | .. | .. | 9 | .. | 9 |
| Chelmsford | 0 | 2 | .. | .. | .. | 2 |
| Haverhill | 0 | .. | 23 | .. | .. | 23 |
| Tyngsboro | 0 | 1 | .. | .. | .. | 1 |
| Wilmington | 0 | .. | .. | .. | 4 | 4 |
| Total | 132 | 79 | 111 | 110 | 147 | 447 |

It will be noted that there was one driver who went into 13 out of the 18 communities in which cases occurred. He was, apparently, the most energetic of the delivery men, since he covered more stores than any other, but even so he seemed to have more than his proportion of the cases. In 9 communities where cases occurred, he was the only driver who delivered the products (Table III). His products alone were responsible for 59 cases in contrast to 19 cases chargeable to the products of the other three drivers. This would indicate that the organism was irregularly distributed in the pastries and that the one driver happened to get the most heavily infected products.

TABLE III

*Outbreak I: Pastry-borne*

*Cases Reported in Communities Visited by One Driver Exclusively*

| *Community* | *Driver No. 1* | *Driver No. 2* | *Driver No. 3* | *Driver No. 4* |
|---|---|---|---|---|
| Lynn | .. | .. | .. | 25 |
| Lawrence | .. | 12 | .. | .. |
| Wakefield | .. | .. | .. | 9 |
| Melrose | .. | .. | .. | 7 |
| Stoneham | .. | .. | .. | 6 |
| Billerica | .. | .. | .. | 3 |
| Everett | .. | .. | .. | 3 |
| Methuen | .. | 3 | .. | .. |
| Reading | .. | .. | .. | 3 |
| Saugus | .. | .. | .. | 2 |
| Somerville | .. | .. | 2 | .. |
| Burlington | .. | .. | 1 | .. |
| Dracut | 1 | .. | .. | .. |
| Malden | .. | .. | .. | 1 |
| Andover | .. | .. | .. | .. |
| Cambridge | .. | .. | .. | .. |
| Chelmsford | .. | .. | .. | .. |
| Haverhill | .. | .. | .. | .. |
| Tyngsboro | .. | .. | .. | .. |
| Wilmington | .. | .. | .. | .. |
| Total | 1 | 15 | 3 | 59 |

It is difficult to believe that all of the cases were caused by pastries delivered on a single day. The date of onset of the first case investigated was March 28, but others continued to occur until the last of May (Table IV). Most of the cases had onsets before the investigation of the outbreak began on April 22. As might

TABLE IV

*Outbreak I: Pastry-borne*

*Dates of Onset*

| *Week Ending* | *No. of Cases* |
|---|---|
| April 3 | 3 |
| April 10 | 19 |
| April 17 | 36 |
| April 24 | 21 |
| May 1 | 18 |
| May 8 | 6 |
| May 15 | 9 |
| May 22 | 3 |
| May 29 | 1 |
| No symptoms | 10 |
| Date not determined | 6 |
| Total | 132 |

be expected with a pastry product popular among children, the incidence was highest among the lower age groups (Table V).

There was a high degree of laboratory confirmation of the diagnosis. Of the 132 cases, positive stools were found in 116 (88 per cent) and positive or partial agglutination for paratyphoid B was found in 102 (77 per cent). In 86 cases (65 per cent) both the stool and agglutination test confirmed the diagnosis (Table IX).

In the search for additional cases, many family contacts were examined. Including examinations on food handlers, the total number of individuals was 222. Some of these had suspicious symptoms but 10 were found to be harboring the organism without having exhibited any symptoms. These 10 were classed as subclinical cases and were included among the 132 cases recorded for the outbreak.

TABLE V

*Outbreak I: Pastry-borne*

*Distribution of Cases by Age and Sex*

| *Age* | *Male* | *Female* | *Total* | *Per cent* |
|---|---|---|---|---|
| 0– 9 | 18 | 21 | 39 | 29.5 |
| 10–19 | 19 | 24 | 43 | 32.6 |
| 20–29 | 5 | 21 | 26 | 19.8 |
| 30–39 | 6 | 7 | 13 | 9.8 |
| 40–49 | .. | 7 | 7 | 5.3 |
| 50–59 | 3 | 1 | 4 | 3.0 |
| Total | 51 | 81 | 132 | 100.0 |

Four individuals were operated upon before it was discovered that they had paratyphoid fever.

OUTBREAK II: IN GIRLS' COLLEGE

Before the investigation of the first outbreak was entirely completed, attention was called to a number of cases of diarrhea and fever among students in a college in Boston. Examination of blood and stool specimens demonstrated that the illnesses were due to paratyphoid B bacilli. A search for further cases and for the source of infection was immediately begun.

The college had an enrollment of approximately 1,700 students. The only common factor was that all those ill had eaten at the college cafeteria on either June 2 or June 3 during examination week. In going over the menus of the two days, it was found that chicken salad had been served on June 2 and what was left over was made into chicken salad sandwiches on June 3. Among those ill, chicken salad was remembered as one article eaten in practically every instance.

The cafeteria employed 62 workers of whom 13 were full-time employees. Eight persons took part in preparing the chicken salad. Five of these were ill the next day of what proved to be paratyphoid fever. Two of them assisted in preparing the chicken salad sandwiches. Two others of the 8 showed no symptoms, but paratyphoid B bacilli were present in stool specimens. One of these showed positive stools for over a year afterward. The agglutination test in the latter was suggestive and has remained so. She is the only individual followed whose agglutination titer has failed to decrease. It is probable but it cannot be proved that she assisted in removing the meat from the chickens and in dicing it for the chicken salad. While it cannot be definitely established that she was responsible for the outbreak, the possibility is very great. It should be noted that the kitchen workers were examined 3 years previously, and she is the only one of the workers employed throughout both periods on whom a record of a stool examination 3 years before cannot be found. Throughout all this period her tasks have consisted largely of washing cooking utensils and preparing raw vegetables for cooking. Attempts to associate any of the kitchen workers with recognized cases in the pastry outbreak or with visits into the area where it occurred were entirely unavailing.

The school had closed before the existence of the outbreak was recognized. An especially urgent problem arose when it was discovered that a number of the students enrolled in home economics courses who had been working in the cafeteria had obtained summer positions as food handlers in cafes, hotels, camps, and other summer resorts. It became necessary to learn the destination of these girls and inform local and state health authorities, as well as prospective employers, that stool specimens should be examined to show that they were not carrying the organism. Some of them, in fact, were found to have positive stools.

It was thought important to inform all of the students and the faculty about the outbreak so that the possibility of being operated upon in the belief that they had appendicitis might be prevented and also in order that they might submit themselves to proper medical supervision if they had developed symptoms after departing from the school. State and local health authorities were also notified so that they might check on any that might be handling food.

Seventy-three individuals were found who had probably been infected by eating at the cafeteria. This certainly does not represent the total number, as other unrecognized cases

undoubtedly must have occurred. However, it is readily understood why a larger proportion of the school was not affected. Since it was examination week, the number served at the cafeteria was smaller than usual. Many took all their meals at home or in other dining rooms connected with the school. Moveover, only those who ate the chicken salad were apparently exposed to infection.

Laboratory confirmation was again quite satisfactory. Out of the total of 73 probable cases, 47 (65 per cent) were confirmed by positive stool cultures, 17 others (23 per cent) by positive or partial agglutination tests, and only 9 were clinical diagnoses (Table IX). Stool specimens were obtained too late to expect to find the organisms in some cases. The agglutination test was not helpful in others because of previous inoculation with triple vaccine. Nine individuals with positive stools gave no history of illness.

The spread of dates of onsets gives some information as to the length of the incubation period. Over 90 per cent became ill in 10 days or less, and over 50 per cent had onsets on the 6th, 7th, and 8th days (Table VI). Some had a mild diarrhea on the first or second day and more severe symptoms, including fever, three or four days later.

TABLE VI

*Outbreak II: In Girl's College*

*Dates of Onset*

| *Date* | *No. of Cases* |
|---|---|
| June 3 | 2 |
| 4 | 2 |
| 5 | 2 |
| 6 | 4 |
| 7 | 3 |
| 8 | 8 |
| 9 | 10 |
| 10 | 10 |
| 11 | 1 |
| 12 | 4 |
| 13 | 0 |
| 14 | 0 |
| 15 | 0 |
| 16 | 1 |
| 17 | 0 |
| 18 | 1 |
| 19 | 1 |
| No Symptoms | 9 |

OUTBREAK III: IN BOYS' SCHOOL

The third outbreak occurred among students and visitors who ate at one or both of two meals served on June 8 during the closing exercises of a boys' private school in the western part of the state a hundred miles from the two previous outbreaks. Both of the meals were prepared by the regular kitchen staff and served by the boys of the school. A large number of those served were relatives and friends of the boys. The menus were very similar and much of the food for the two meals came from the same large containers. Chicken salad, potato salad, turkey dressing, and ice cream were the articles which came under suspicion.

Examination of the food handlers of the school and of the ice cream company failed to reveal a single individual who gave a history of having been ill previous to the outbreak or who showed a positive stool or agglutination test for paratyphoid B.

There was no way of obtaining a complete list of the individuals who had attended the exercises. It was estimated that more than 1,000 may have been exposed. The students had already left school when the investigation began, dispersing to all parts of the United States. Some of them were already on board ship bound for Europe.

Notices were sent to all registered students calling their attention to the possibility of their having been exposed to the infection and recommending that they place themselves under the care of a physician if they had shown any symptoms. They were also warned that those with subclinical infections might convey the disease to

TABLE VII

*Outbreak III: In Boys' School*
*Dates of Onset*

| Date | No. of Cases |
|---|---|
| June 9 | 2 |
| 10 | 40 |
| 11 | 72 |
| 12 | 7 |
| 13 | 1 |
| 14 | 1 |
| 15 | 0 |
| 16 | 3 |
| 17 | 1 |
| 18 | 1 |
| Unknown | 2 |
| No symptoms | 1 |

their contacts. State and local health officers were notified of the home addresses of the students.

The number found who had shown symptoms leading to the suspicion of a paratyphoid infection eventually totaled 130. Of this number, 12 had positive stools, 30 others showed positive or suggestive agglutination tests for paratyphoid B, 63 either negative stools or agglutination tests or both, and no specimens were obtained on 25 individuals (Table IX). While laboratory evidence of paratyphoid B infection was obtained in only 30 per cent of the cases, the fact that most of those ill showed onsets within 48 hours after the meals were served would indicate that they contracted their infection at the school (Table VII). That the illnesses were something more than so-called "intestinal grippe" is suggested by the duration of symptoms which averaged spproximately 4 days (Table VIII).

TABLE VIII

*Outbreak III: In Boys' School*
*Duration of Symptoms*

| Days | No. of Cases |
|---|---|
| 1 | 7 |
| 2 | 9 |
| 3 | 18 |
| 4 | 20 |
| 5 | 18 |
| 6 | 3 |
| 7 | 7 |
| 8 | 2 |
| 9 | 0 |
| 10 | 0 |
| 11 | 1 |
| 12 | 0 |
| 13 | 0 |
| 14 | 2 |

Either stools or blood samples were examined from 75 other individuals who showed no symptoms. Some of these were the food handlers mentioned above. One individual, a student, was found to have a positive stool and 4 individuals were found to have suggestive agglutination tests. These 4 gave a history of having received typhoid-paratyphoid vaccine inoculations.

OUTBREAK IV: CHRISTENING PARTY

The fourth outbreak was a small one which occurred after a christening party on August 15 held in a town near Springfield. This town was thirty miles from the school in which the third outbreak occurred and a hundred miles from the other two. Twenty-nine individuals were probably exposed either by eating at the party or by consuming food which had been prepared for the occasion. Among those exposed, 13 are known to have shown symptoms, of whom 5 had positive stools, 3 others showed positive or suggestive agglutination tests and 5 showed negative tests (Table IX).

In searching for the source of the infection, it was noted the illnesses were limited almost entirely to visitors in the home of the christened child where the party had been held. The father of the child had been ill 10 days before the outbreak. His symptoms, consisting of vomiting and diarrhea, and lasting 5 days, were of sufficient severity that he had gone to a nearby hospital where he was told that he had colitis, but no stool specimens were cultured there. Paratyphoid bacilli were not found in his stool at the time of the investigation, so it is impossible to show that he was responsible for the outbreak, particularly since he had taken no part in pre-

TABLE IX

*Summary of Laboratory Confirmation of Cases of Paratyphoid B*

| | *Probable Cases* | *Positive Stools* * | *Positive Agglutination* | *Negative Examinations* | *No Examinations* |
|---|---|---|---|---|---|
| Outbreak 1 | 132 | 116 | 16 | 0 | 0 |
| Outbreak 2 | 73 | 47 | 17 | 6 | 3 |
| Outbreak 3 | 131 | 13 | 30 | 63 | 25 |
| Outbreak 4 | 13 | 5 | 3 | 5 | 0 |
| Sporadic, 1937 | 47 | 38 | 3 | 6 | 0 |
| Total for 1937 | 396 | 219 | 69 | 80 | 28 |

* Many of these also showed positive agglutination tests.

paring the food except for assisting in making pickles. A 4 year old boy was the only member of the household to become ill after the party. All laboratory tests on specimens from members of the family were negative.

## DISCUSSION

It has been impossible to trace any connection between these outbreaks. People infected in the first outbreak may have carried the organism to many other parts of the state, but so far no such individuals have been found. The fact that 20 with positive stools and 11 others with positive agglutination tests were entirely without symptoms emphasizes the importance of subclinical infections in this disease and illustrates why its control may be difficult. One of the fundamentals of such control is the ability to recognize cases. When missed cases occur, difficulties increase.

The persistence of the organism in the stools of convalescents adds an additional problem. It will be noted that almost half of those who showed positive stools were still carrying the organism at the end of 5 weeks, one-eighth at the end of 9 weeks (Table X). Others continued positive until

TABLE X

*Persistence of Positive Stools*

| | *Week Last Positive Stool Found* | | | | | | *Cases Still Positive Each Week* | |
|---|---|---|---|---|---|---|---|---|
| | *Outbreaks* | | | | | | | |
| *Week* | *1* | *2* | *3* | *4* | *Sporadic Cases* | *Total* | *Number* | *Per cent* |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 205 | 100.0 |
| 2 | 8 | 5 | 3 | 1 | 4 | 21 | 204 | 99.5 |
| 3 | 23 | 14 | 4 | 2 | 6 | 49 | 183 | 89.3 |
| 4 | 20 | 4 | 2 | 0 | 8 | 34 | 134 | 65.4 |
| 5 | 16 | 6 | 1 | 1 | 2 | 26 | 100 | 48.8 |
| 6 | 10 | 6 | 0 | 0 | 6 | 22 | 74 | 36.1 |
| 7 | 13 | 2 | 1 | 0 | 3 | 19 | 52 | 25.4 |
| 8 | 7 | 0 | 0 | 0 | 0 | 7 | 33 | 16.1 |
| 9 | 6 | 2 | 0 | 0 | 2 | 10 | 26 | 12.7 |
| 10 | 3 | 0 | 0 | 0 | 0 | 3 | 16 | 7.8 |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 6.3 |
| 12 | 1 | 0 | 0 | 0 | 0 | 1 | 13 | 6.3 |
| 13 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 5.8 |
| 14 | 1 | 0 | 0 | 0 | 0 | 1 | 12 | 5.8 |
| 15 | 1 | 0 | 0 | 0 | 0 | 1 | 11 | 5.4 |
| 16 | 0 | 0 | 1 | 0 | 0 | 1 | 10 | 4.9 |
| 20 | 0 | 0 | 0 | 0 | 1 | 1 | 9 | 4.4 |
| 28 | 1 | 0 | 0 | 0 | 0 | 1 | 8 | 3.9 |
| 32 | 1 | 0 | 0 | 0 | 0 | 1 | 7 | 3.4 |
| 49 | 0 | 1 | 0 | 0 | 0 | 1 | 6 | 2.9 |
| 52+ | 4 | 0 | 0 | 0 | 1 | 5 | 5 | 2.4 |
| Total | 116 | 40 | 12 | 4 | 33 | 205 | | |

the 28th, 32nd, and 49th weeks, and 5 permanent carriers have been added to our list.

Indications are that the disease will continue in the state for some time. During 1937, 47 sporadic cases were discovered in various parts of the state, practically all of them occurring subsequent to the outbreaks. In the first 9 months of 1938, 66 cases have been reported. Six small outbreaks, totalling 48 cases, occurred in families or in groups eating a common meal. The other 18 were sporadic cases.

## SUMMARY

1. There was a marked increase in the incidence of paratyphoid fever in Massachusetts in 1937.

2. Of 267 reported cases, 220 were associated with four outbreaks and the other 47 were sporadic cases.

3. The vehicle carrying the infection was discovered in two outbreaks (pastry in one, chicken salad in the other), and suspected (chicken salad) in a third.

4. Individuals handling food were found with positive stools in two outbreaks. It could not be definitely proved that they were the source.

5. There were 396 individuals suspected of having paratyphoid B infections: 219 were found to have positive stools, 72 others showed positive or suggestive agglutination tests but negative stools, and 105 were unconfirmed by laboratory examinations.

6. Four individuals were operated upon for appendicitis before the outbreaks were discovered.

7. Five cases have continued for 12 months to excrete paratyphoid B bacilli and have been placed on the carrier list. This is a rate of about 2 per cent permanent carriers, which corresponds to the rate observed for typhoid fever in Massachusetts.

8. Attention is called to the importance of subclinical infections in the control of the disease.

9. Paratyphoid B fever has apparently become established in Massachusetts; 66 cases have already been reported in 1938.

# Relation of the Coroner's Office to the Bureau of Vital Statistics*

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THE relation between the coroner's office and the bureau of vital statistics has become, in recent years, a problem of vital concern to both groups. Their functions so overlap that each has become more or less dependent on the other for a necessary portion of its work. Because of this it is not only desirable but mandatory that a harmonious reciprocal relationship shall exist between the two offices. This may result only when a meticulous, businesslike attitude prevails in regard to the duties of each office, particularly as to the overlapping functions; when competent, properly trained individuals are employed in both departments, and when resentment ceases against the expenditure of a small amount of extra effort, when occasion demands.

## Duties of the Coroner

It first must be emphasized that the function of the coroner is a vital one. It is one of the least recognized and considered the least important of public offices; yet, sometimes its function far surpasses that of other public offices in importance. For this reason and because its major function has a bearing on the duties of the bureau of vital statistics, its importance cannot be overemphasized. The office investigates and establishes the causes of certain types of death and the circumstances as defined by state law. This varies somewhat from state to state but, on the whole, there is general agreement. This process, depending upon the incumbent, can be a short, cut and dried, superficial procedure, or a thorough investigation, employing all the armamentarium of science to reach a truthful conclusion. The highest type of procedure of this nature is exemplified by the Medical Examiner's System of New York City. In Cleveland, we pride ourselves on the fact that we are following essentially the same procedure with a fair measure of success, in so far as the state law permits.

Unless all the tools of science—the laboratories of chemistry, pathology, bacteriology, immunology, and ballistics, together with all the evidence derived from the examination of witnesses—are available to the coroner (or medical examiner) he is hampered in his investigation. Having these, the performance of tests and the securing of necessary evidence enables the coroner to make an exhaustive and accurate analysis and to reach his decision sooner. It cannot be too much emphasized that the accuracy of the coroner's verdict varies directly with the accuracy and completeness of his investigation, and similarly affects the statis-

* Read at a Joint Session of the American Association of State Registration Executives and the Vital Statistics Section of the American Public Health Association at the Sixty-seventh Annual Meeting in Kansas City, Mo., October 26, 1938.

tical survey or record of the bureau of vital statistics.

It may be well to point out that not a small part of the statistical information regarding deaths is transmitted from the coroner's office to the bureau of vital statistics. Assuming our experience in the County of Cuyahoga to be representative of the country as a whole, about 12–15 per cent of the deaths in the county are handled by the office of the coroner.

To emphasize the necessity for complete and accurate investigation, many cases can be mentioned where individuals met death as the result of foul play, the true nature of the case being hidden by a series of circumstances in superficial and incomplete investigations. These have been cleared up and the guilty persons brought to justice only through the employment of the laboratory aids mentioned. Conversely, cases are on record where deaths have occurred under highly suspicious circumstances and where innocent individuals have had their lives or liberty placed in jeopardy until the true state of affairs was revealed by these very laboratory aids. Though primarily for the purpose of the coroner's function and record, the accuracy of the investigation affects equally, though secondarily, the work of the bureau of vital statistics.

A function of the coroner's office that is more obviously related to the function of the bureau of vital statistics is the filling out and turning over of the completed certificate of death as soon as possible. I must stress the importance of having a liberal coöperative individual in charge of the local bureau of vital statistics who can understand that on occasion much time may elapse before chemical, bacteriological, pathological, and immunological procedures can be carried out, and as a result the report with the cause of death must be deferred. This may be irksome, entail more work, and cause some delay in the functions of the bureau of vital statistics, but for the sake of the truth, these handicaps must be accepted gracefully. I have learned that this very act may often be the source of friction between the offices in various parts of the country. Delays of several months to a year have occurred. This to me seems entirely unnecessary except on possible rare occasions.

We have established a working relationship with the Bureau of Vital Statistics which I consider ideal and practical. Probably there is nothing original in it, and parts may be in force in various coroners' offices throughout the country; yet I hope it is of sufficient value to bear explaining.

The majority of our cases are settled conclusively by the Coroner's investigation and/or the gross pathological examination. As the result, the cause of death can be arrived at in very short order, the death certificate filled out, and the information made available to the Bureau of Vital Statistics, within a few up to 24 hours. Should subsequent, more minute histological or chemical examination reveal such additional evidence as to cause a change in the recorded cause of death, this is made in our records and the information is also conveyed to the Bureau of Vital Statistics. Though this entails some trouble, it rarely occurs and is preferable to waiting over a longer period (7 to 10 days) for the final report.

In those few cases, in which there is suspicion or doubt and the Coroner's report is thereby incomplete, the death certificate is filled out with the exception of the cause of death, which is marked "Deferred." Where burial must take place prior to the completion of the Coroner's verdict, the registrar coöperates by issuing a temporary burial permit with our release of the body so as not to inconvenience the

family and undertaker unnecessarily. These cases are usually completed at the end of 1 or 2 weeks, rarely as long as 3 weeks, and the case is closed, statistically speaking.

The personality of the head of each office is important. Naturally, if either or both individuals are short-tempered, impatient, intolerant, and petulant, questions and complaints may arise, which result in ill-will, lack of coöperation, and clash of temperaments, which in turn may produce more irritation thereby setting up a vicious circle of non-coöperation. Personal contact between the heads of the two departments, particularly when questions or criticisms arise, tend to prevent ill-feeling and promote good will.

With the conclusion of his verdict, there may be a tendency on the part of a coroner to consider his official duties as completed and his responsibility to the bureau of vital statistics as over when he fills out the death certificate and hands it over.

Our office does not rest with that and this is probably the secret of the excellent relationship between the two offices in Cleveland. Not only for our own records, which we strive to keep as complete and accurate as possible for statistical investigation or scientific information, but also for the sake of the data necessary for the local bureau of vital statistics, we secure all possible facts pertaining to the cases. Naturally, where human effort is involved, machine-like precision and accuracy are impossible and errors may and do occur. These errors we check and correct as rapidly as possible. In addition (and very important), we have developed an " esprit de corps," whereby when a request comes from the Bureau of Vital Statistics the information is immediately secured though we may not be directly responsible for that particular bit.

This coöperation and failure to draw a sharp line of demarcation where our functions end and those of the Bureau of Vital Statistics begin is one of the reasons for excellent relationship between the offices.

We have found that certain errors occur more frequently than others on the certificates of death, and that these are a source of irritation and additional trouble to the Bureau of Vital Statistics. The data most often lacking or inaccurately supplied pertain to " Place of Death," " Classification " and " Place of Residence." Many contradictions in the certificate also occur. These errors can and should be avoided by having a qualified individual perform this service personally, or appointing one of the staff to check the facts.

One important source of irritation is the question of legibility. Most physicians fill out their certificates of death with pen and ink, and very frequently the writing is illegible. The typewriter is more satisfactory, but multiple erasures, crowding of words, or typing over words or letters make such a certificate as bad as one illegibly handwritten.

## FUNCTIONS OF THE BUREAU OF VITAL STATISTICS

Since we are concerned solely with cases of death that come under our jurisdiction, I shall limit myself entirely to that portion of its work that concerns itself solely with the collection of mortality statistics.

The Director of the Census considers a 90 per cent accuracy in the vital statistics of mortality in any one locality a satisfactory minimum, yet the percentage of error permitted statistically is extremely large. I would assume the purpose of the present activity and effort is directed toward a greater accuracy and facilitation of activity. In some areas, accuracy is greater than others. It would appear that tendency toward error would be

greater where specialization is less, as in the smaller towns, townships, and villages, where the local clerk acts as registrar of vital statistics and in any other capacity necessary. It follows that his expertness in some must suffer.

That there is a definite need that those employed in the bureau of vital statistics be specially trained and educated in medical matters can be well shown by daily practices. First, simple errors in filling in the necessary data, or contradictions, frequently appear in certificates of death, and it requires knowledge and patience to ferret out these mistakes. Occasionally, causes of death are given, either by design or ignorance, that are vaguely or incorrectly stated, and the registrar or clerk must be on the alert for these errors, especially when there is an attempt to "cover up" a suspicious death.

Perhaps the most important and serious function of the bureau of vital statistics as far as the function of the coroner's office is concerned, is the noting of those certificates signed by private physicians, in cases that should have been investigated by the coroner. In this one function, all the faculties of specialized knowledge and education on the part of the clerk must be uncovered in order to prevent such illegal procedure and assist the coroner in the fulfillment of his duty to society.

Criticism of the coroner's office and of the bureau of vital statistics occasionally occurs, and if offered and met with a fine corrective and coöperative spirit, results in improved relationships, and this eventuates in the desired end of accurate knowledge of statistical data. Such a relationship exists between our office in Cuyahoga County and the Bureau of Vital Statistics of Cleveland, Ohio. Occasionally, errors have occurred, and these chiefly in some of the smaller townships and villages where the personnel in office are not specifically trained.

Occasionally the interpretation of the definition of "Coroner's Cases" comes to the attention of the Bureau of Vital Statistics in connection with the question of who shall sign the certificate of death. This concept varies somewhat from state to state, but the interpretation should be liberal in favor of the coroner. The reason for this lies in the premise that it is better to take no unnecessary chances in questionable cases and allow the matter to be settled by the coroner. Usually this can be settled either by a telephone conversation with a presentation of the facts or a brief police investigation. If the coroner presents a certificate of death in any case, his should be accepted in preference to one presented by a private physician. In making such a statement, I assume that no extra fee is made available to the coroner by such effort, so that no selfish interests motivate him.

### SUGGESTED IMPROVEMENTS

A study of this type cannot be considered complete without some suggestions for improvement in the relation between the two offices or in the function of each. One such suggestion, in order to prevent passing "Coroner's Cases" signed by private physicians, is to supply the coroner's office with a duplicate copy of death certificates filed each day. This would entail extra work, but it could be limited to the smaller localities, and particularly to those where there is no medical officer in direct charge of the bureau of vital statistics. The expense and trouble would be repaid by the results. It would also cause extra work on the part of the coroner, but he should not protest, since he would be the one to benefit.

The certificate of death used in coroner's cases, is the same as that used in any other case. When a death becomes a coroner's case certain data are

necessary that distinguish it from others, though no room is available for these specialized data on the regular death certificate. These data are of a type suitable for statistical handling, and much statistical knowledge could be drawn from them. Dr. Halbert L. Dunn, has proposed several supplementary forms for fatal traffic accidents. That is an excellent start. Similar specialized forms should be made available for all the other types of cases that come under the jurisdiction of the coroner, including all homicides, other types of accidents, suicides, and the like. Final analysis of the data secured should prove exceedingly interesting and valuable.

In certain areas, confusion exists between the two offices, chiefly in those localities where there are more than one coroner for a given area. Such a set-up allows confusion because of the tendency to pass responsibility and blame. This can only be improved by altering the system so that there may be a central office of responsibility.

After securing the proper assistance and equipment, an attempt should be made to function in an ideal manner, for which I can suggest no better model than the Medical Examiner's Office, as it now functions in New York City.

## CONCLUSION

I have suggested an outline for the ideal functioning of the offices of the coroner and the bureau of vital statistics, and for ideal coöperation between the two offices. Suggestions are made for the improvement of certain functions, for the betterment of relationships and for greater accuracy of statistical data.

# Analysis of the Subsequent Course of Diagnosed Cases of Tuberculosis*

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THE use of life table procedure in studying morbidity and mortality of those in familial contact with tuberculosis[1] was discussed before the Epidemiology Section of the American Public Health Association by Frost in 1932. Since that time the method has been applied to material in the field of tuberculosis by many of his students. Dr. Frost was also especially interested in the extension of the life table procedure to the study of the course of the disease, which necessitated the development of a method of handling the information regarding the cases as to death (from all causes) retrogression, or improvement of the patients. His intense interest in this analysis was in large part responsible for the development of the method presented here.

The death and survival rates of cases of tuberculosis were summarized by Brieger[2] in 1937, and the expectation of survival in pulmonary tuberculosis has been shown for cases at the Brompton Hospital.[3] In many of these studies the status of cases (living or dead) at certain time intervals after admission to, or discharge from sanatoria was known. For cases found in this study, however, the periods of continued observation vary, and from the standpoint of development of a better control program it seems important to study the changes in status of tuberculosis cases currently. In the analysis of such clinical data it is necessary to assemble the observations in a form which takes account of the time during which each case remained under observation. For such accounting some modification of the conventional life table is the most convenient method to use.

The procedure followed in calculating the mortality experience will be discussed first. The death rate which it is desired to obtain is the rate known in life tables as the "probability of death" ($q_x$) within a year. This is expressed by the ratio $q_x = \frac{d_x}{l_x}$ where $l_x$ is the number present at the beginning of the year and $d_x$ is the number of those who died within the year. This statement, however, assumes that all those not known to have died within the year can be known to have survived through the year. In the data available, some of the cases were under observation less than a full year while others moved from the county so that the period of observation terminated within a year after

* Read before the Vital Statistics Section of the American Public Health Association at the Sixty-seventh Annual Meeting in Kansas City, Mo., October 28, 1938.

first observation. Thus a certain number ($w_x$) of those who entered the experience ($l_x$) were withdrawn from the experience during the year. Each of the persons thus withdrawn is counted as having been exposed to (and survived) ½ year's experience so that the number at risk for the whole year is taken as

$$l_x - \tfrac{1}{2}w_x \quad \text{and} \quad q_x = \frac{d_x}{l_x - \tfrac{1}{2}w_x}.$$

The probability of survival can be obtained by subtraction of the probability of death ($q_x$) from 1, as $p_x = 1 - q_x$. If $100q_x$ is the percentage dying during a year, $100p_x$ is the percentage surviving through the year.

From the percentages surviving each year the percentage of those originally at risk who survived $\underline{h}$ years can be obtained. Thus, since $100p_x$ survive the first year and $100\ p_{x+1}$ of these survive through the second year, the proportion of the original number who survive through 2 years ($100_2p_x$) is equal to $100\ (p_x \times p_{x+1})$. The risk of dying within the first $\underline{h}$ years ($100_hq_x$) is $100(1 - {}_hp_x)$.

To illustrate the method, the mortality of cases of moderately advanced tuberculosis during the 4 years following diagnosis is shown in Table I.

Of the 86 persons entering into this experience ($l_x$) 20 were withdrawn (living) from the experience during the first year ($w_x$) and 11 died during the first year ($d_x$). The number at risk was $86 - \frac{20}{2} = 76$ and the death rate per 100 was $100 \times \frac{11}{76} = 14.5$ per cent. In column 6 the percentage surviving each year is given and it is seen that 85.5 per cent survived the first year. Since 85.5 per cent survived the first year and 93.9 per cent of those entering the experience in the second year survived through the year, the proportion of the original number who survived through 2 years was 100 $(.855 \times .939) = 80.3$ per cent. Similarly, the proportion of the original number who survived through 3 years was 100 $(.855 \times .939 \times .840) = 67.5$ per cent, and through 4 years 59.1 per cent. From these percentages of those originally at risk surviving through the preceding and current year the percentages dying can be obtained, as $100_hq_x = 100\ (1 - {}_hp_x)$. The risk of dying in the 4 years was 40.9 per cent.

In addition to mortality rates, the experience in regard to other changes in clinical status can be obtained from these observations. In analyzing the data it is necessary (1) to discuss the number of cases that retrogressed or improved among *survivors*, and (2) to base the changes on the number of people *examined*, as changes other than death are found only by examination. The number of survivors examined in a given year varies with the frequency of examination of the cases in the different clinical groups. Some of the cases were not reëxamined until the second year following diagnosis. It is not assumed that the changes are recorded for the period in which they occurred but rather for the period in which they were discovered by a subsequent examination. As death is considered the most important observation during a year it is given precedence over any other possible change.

The percentages of retrogressed and improved cases are based on the survivors of a given year who were examined.

As the numbers of survivors through succeeding years can be obtained from the mortality experience, it remains to relate the changes among the persons examined to all survivors. To do this it is assumed that all survivors retrogress or improve at the same rate as

TABLE I

*Mortality of Cases of Moderately Advanced Tuberculosis During 4 Years Following Diagnosis*

| | Number Present at Beginning of Year | Number Withdrawn (Living) During Year | Number Dying During Year | Average Number at Risk During Year | Percentage Dying During Year | Percentage Surviving Through Year | Percentage Surviving Through Preceding and Current Year | Percentage Dying in Preceding and Current Year |
|---|---|---|---|---|---|---|---|---|
| | $l_x$ | $w_x$ | $d_x$ | $l_x - \frac{1}{2}w_x$ | $100q_x$ | $100p_x$ | $100_hp_x$ | $100_hq_x$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 1st year | 86 | 20 | 11 | 76.0 | 14.5 | 85.5 | 85.5 | 14.5 |
| 2nd year | 55 | 11 | 3 | 49.5 | 6.1 | 93.9 | 80.3 | 19.7 |
| 3rd year | 41 | 7 | 6 | 37.5 | 16.0 | 84.0 | 67.5 | 32.5 |
| 4th year | 28 | 8 | 3 | 24.0 | 12.5 | 87.5 | 59.1 | 40.9 |

those examined. The effect of this assumption may slightly exaggerate the retrogression rates and minimize the improvement rates since those individuals who were reëxamined may have included a higher proportion of those retrogressing than of those improving. However, it is not felt that this factor is of such significance as to invalidate any of the results obtained. Although all cases are included in the mortality experience until death or the end of observation, they are included in this experience only until retrogression or improvement is recorded; thus, those at risk for retrogession and improvement do not include all those at risk for death and an adjustment is made to account for deaths among those already retrogressed or improved. To prevent overcounting of those eliminated from the experience, the assumption is made that the mortality in the whole group is the same regardless of any changes in classification. Such an assumption may result in an overcounting in deaths among those who improved and an undercounting among those who retrogressed.

The procedure followed in obtaining the status of tuberculosis cases classed as moderately advanced on initial examination is shown in detail in Table II. Three types of changes are noted: death, retrogression to far advanced disease, and improvement by arrest of the disease or by change in extent so that the classification was changed to one indicating a less extensive lesion. As the mortality experience was given in Table I it is necessary now to relate the percentages showing retrogression or improvement among those examined to the survivors. In the first five columns of the table the actual findings of the survivors who were examined are given. For instance, in the first year, of the 32 survivors examined, 5 retrogressed to far advanced disease (15.6 per cent), and 2 improved so that the clinical classification was altered (6.2 per cent). In the second year, of the 25 survivors examined who had not already retrogressed or improved, 4 retrogressed (16.0 per cent) and 4 improved (16.0 per cent). As the time period after diagnosis increased the number of survivors examined became smaller, since many of the cases were eliminated by retrogression or improvement.

In columns 6–11 inclusive of Table I the survivors are discussed on the basis of 100 or in terms of percentages. The percentage surviving through the preceding and current year, column 7 of Table I, is repeated in column 6. Of the survivors only those who had not improved or retrogressed in a previous interval were at risk for change and these percentages are given in column 7. To obtain the number of survivors who retrogressed on the basis of 100 it is necessary to apply the percentage of retrogressions among examined survivors (col. 3) to all sur-

TABLE II

*Status of Cases of Moderately Advanced Tuberculosis for 4 Years Following Diagnosis*

| | *Survivors Examined* | | | | | *Survivors—Basis of 100* | | | | | | *Status at End of Each Year Cumulative—Basis of 100* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Retrogressed* | | *Improved* | | | | | | | | | | | |
| | *Total No.* | *Number* | *Per cent* | *Number* | *Per cent* | *Through Preceding and Current Year* | *At Risk for Retrogression or Improvement* | *Retrogressed Each Year* | *Improved Each Year* | *Deaths Among Retrogressed* | *Deaths Among Improved* | *Dead (All Causes)* | *Retrogressed* | *Improved* | *Unchanged* |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) |
| 1st year | 32 | 5 | 15.6 | 2 | 6.2 | 85.5 | 85.5 | 13.3 | 5.3 | ... | ... | 14.5 | 13.3 | 5.3 | 66.9 |
| 2nd year | 25 | 4 | 16.0 | 4 | 16.0 | 80.3 | 62.8 | 10.0 | 10.0 | 0.8 | 0.3 | 19.7 | 22.5 | 15.0 | 42.8 |
| 3rd year | 11 | 3 | 27.3 | 2 | 18.2 | 67.5 | 36.0 | 9.8 | 6.6 | 3.6 | 2.4 | 32.5 | 28.7 | 19.2 | 19.6 |
| 4th year | 3 | 0 | .... | 1 | 33.3 | 59.1 | 17.2 | ... | 5.7 | 3.6 | 2.4 | 40.9 | 25.1 | 22.5 | 11.5 |

vivors at risk (col. 7) making the assumption that all survivors retrogress at the same rate as the examined ones. For the first year the number at risk was equal to the number who survived (85.5 per cent); the number who retrogressed was 13.3 per cent ($85.5 \times .156$); and the number who improved, 5.3 per cent ($85.5 \times .062$). While 80.3 per cent of the original 100 survived 2 years, 18.6 per cent improved or retrogressed during the first year. Theoretically, a certain percentage of those who retrogressed or improved in the first year were counted among the deaths in the second year and since death takes precedence over other changes an adjustment was made of 1.1 as the number of deaths on the basis of 100 expected during the second year among those who retrogressed and improved in the first year. This number was obtained by applying the death rate in the moderately advanced for the second year (col. 5 of Table I) to the numbers who retrogressed and improved (col. 8 and 9 of Table II). For example, for the second year the number of deaths on the basis of 100 among those who had retrogressed was 0.8 ($.061 \times 13.3 = 0.8$). In all, there were $80.3 - (13.3 - 0.8) - (5.3 - 0.3)$ or 62.8 per cent who were at risk for change in the second year. Of those in the experience 10.0 per cent retrogressed ($62.8 \times .160$) and 10.0 per cent improved ($62.8 \times .160$) during the second year.

In the last four columns of the table the results of this analysis are summarized to show the changes over a 4 year period of 100 persons entering into the experience. The percentages of those at risk who were dead from all causes by the end of each succeeding year following diagnosis are repeated in column 12. In column 13 are given the proportions of the original number who retrogressed by the end of each year. These percentages are obtained by totalling the number who retrogressed (col. 8) and subtracting the theoretical number of deaths among them (col. 10). For example, by the end of the second year 23.3 per cent had retrogressed, but 0.8 per cent was subtracted for deaths leaving 22.5 per cent of this group who retrogressed and survived. By the end of the fourth year 25.1 per cent had retrogressed. The percentages of those entering this experience who improved (col. 14) are found in a similar way, and by the end of the fourth year 22.5 per cent had improved. Cases who had neither retrogressed nor improved were considered "unchanged" (col. 15).

This method has been applied to

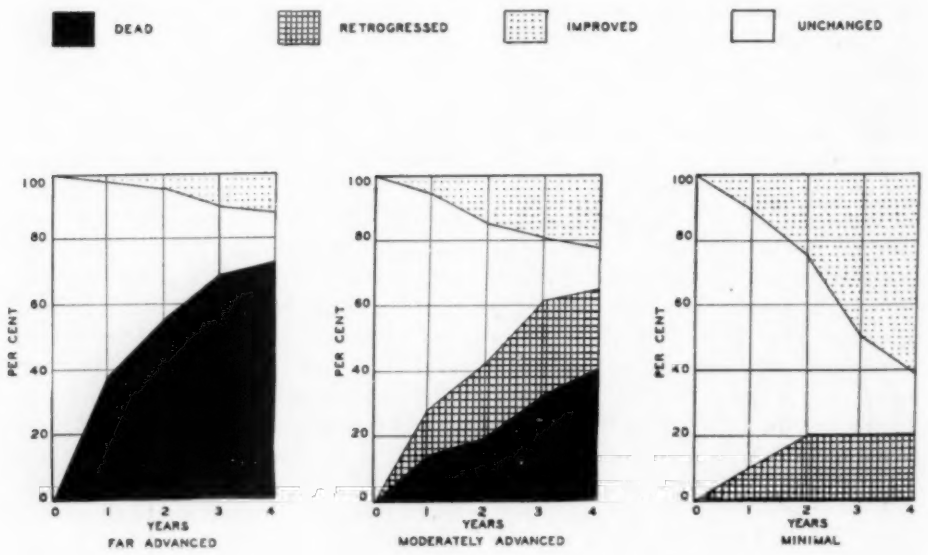
the data collected in the Williamson County Tuberculosis Study. As this present paper is primarily concerned with a statistical method of analysis of clinical data, you are referred to a paper[4] in the November issue of the *American Journal of Hygiene* for a more detailed description of the material. However, the course of the disease in far advanced, moderately advanced, and minimal cases in white and colored population groups is shown in the two graphs. The difference in the course of the disease according to the extent of lesion on diagnosis is apparent. The status of cases of tuberculosis in the white population is shown in Figure I. Of those far advanced on diagnosis 73.1 per cent died within the 4 years, and 12.0 per cent improved during the same period. The percentage of those with moderately advanced tuberculosis dying within the 4 years following diagnosis (40.9 per cent) was much lower. However, with the addition of 25.1 per cent of the moderately advanced cases who retrogressed to far advanced condition it is seen that the course of the disease was unfavorable. Of those with minimal tuberculosis 61.4 per cent improved, 19.5 per cent retrogressed, and 0.9 per cent died during this period.

The course of the disease was more rapid for the colored cases as is shown in Figure II. Of the far advanced colored cases, nearly half (48.4 per cent) were dead within 3 months after diagnosis, 79.6 per cent were dead by the end of the first year, and 87.8 per cent by the end of the second year. The percentage of those with moderately advanced tuberculosis dying within 2 years was 63.1. No improvements were recorded for far advanced or moderately advanced colored cases.

FIGURE I

STATUS OF CASES OF TUBERCULOSIS FOR FOUR YEARS FOLLOWING DIAGNOSIS

WHITE

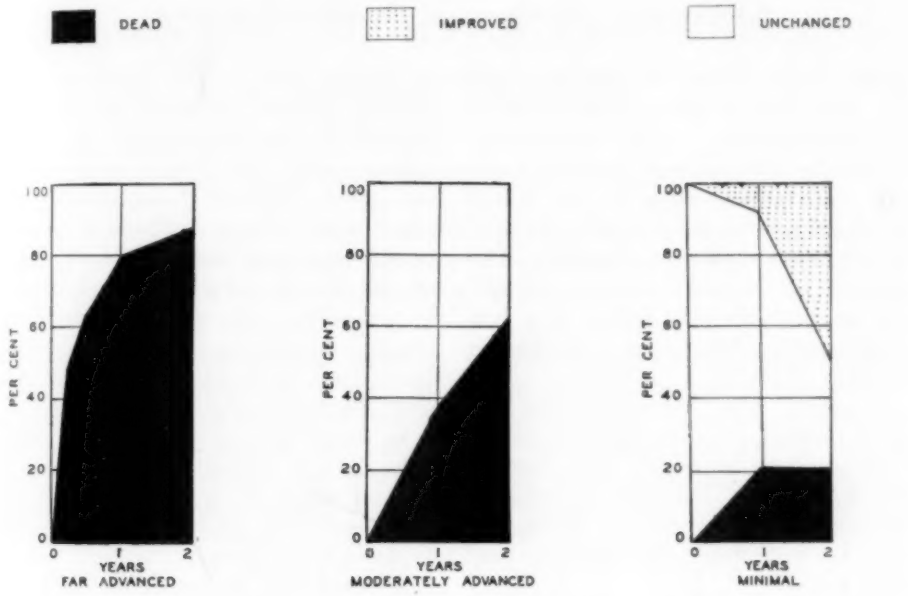



WILLIAMSON COUNTY TUBERCULOSIS STUDY

FIGURE II

STATUS OF CASES OF TUBERCULOSIS FOR TWO YEARS FOLLOWING DIAGNOSIS

COLORED




WILLIAMSON COUNTY TUBERCULOSIS STUDY

However, as improvements were noted for those minimal on diagnosis the prognosis for this group appeared to be more favorable.

The analysis of material according to the procedure which has been outlined should be of value to any person charged with the administration of an efficient program for the control of tuberculosis. This method can be extended to studies of other specific aspects of tuberculosis in various age, sex, and color groups and to the studies of other diseases and conditions affecting health.

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# DISCUSSION

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THE only remarks I wish to make upon Miss Puffer's paper are those of commendation. Some modification of the life table method constitutes our only tool of real value in our search for an answer to many of our epidemiological and medical problems. The modification the authors have developed for the problem with which they had to deal seems adequate and is applicable to other problems.

I suspect that the reason the life table method or some modification of it is not more frequently used may be due to the fact that the keenness of this tool is not realized, or we are too lazy to undertake the thinking and work involved.

One naturally thinks of the desirability of using such a method in trying to determine the effect of different kinds of treatment on cases of tuberculosis. Not everyone is in agreement, for example, as to the efficacy of the modern surgical treatment of tuberculosis, such as thoracoplasty. The application of such a method as developed by the authors to two large groups of tuberculosis cases, all in the same stage, one group without thoracoplasty, the other with, and a comparison of the results obtained for the two groups should furnish some definite assistance in evaluating this particular kind of surgical treatment. While this has been done, perhaps other studies are desirable to get additional evidence.

In studying many, if not most, problems, it goes without saying that the method would have to be applied to two observation groups; one, of course, to serve as a control.

I would like to ask Miss Puffer as to the number of cases on which the results set forth in the charts are based. The life table method, I judge, would call for a fairly large sample for accurate results.

It has been a pleasure to study and hear this paper presented.

# Uses and Abuses of Biochemical Oxygen Demand*

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AS a control test in the treatment of sewage by oxidative processes, as a measure of the pollutional strength of organic industrial wastes, and as a yard-stick in the survey of polluted waters, the biochemical oxygen demand determination has become the most widely used test in modern sanitary control of all liquid wastes. Like most tests which have been devised to measure the progress of natural biologic phenomena it has its uses and it has its limitations. Since the determination is in reality a measurement of biologic oxidation or, more strictly speaking, of the mass metabolic rate of a heterogenous group of microörganisms, average conditions for normal biological growth must be maintained if optimum results are to be expected.

With domestic sewage these conditions are met satisfactorily since this waste is a mixture of various types of materials which have already partially undergone the degradation process which befalls all biologic material. Moreover, the bacterial floral which accompany this waste find their conditions of existence simply extended to the final stage in the process—the oxidation and mineralization of these organic matters. This domestic sewage may then be classed as a natural habitat of the organisms which are to perform the oxidation, and for that reason we may expect more concordant results when this waste is under consideration. Experience has shown this to be true. The B.O.D. of these wastes seems to offer the best single test of their pollutional strength. Industrial wastes, on the other hand, are more apt to be unbalanced in their composition and therefore not so suitable for bacteria propagation and the concomitant oxidation which always accompanies the aerobic attack of bacteria on organic matter.

Beet sugar, beet canning, paper, pulp, and strawboard wastes are good examples of industrial wastes which are high in carbohydrate material. Some of these may be so lacking in compounds of nitrogen and phosphorus that only a small fraction of the real B.O.D. will be obtained if standard procedure is followed. Mineral, chemical, and coke oven wastes are entirely unsuitable for the application of this biologic test. Moreover, those organic wastes high in nitrogenous constituents provide normal conditions for bacterial action, but the

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5 day period commonly employed may only give a small fraction of the total oxygen requirement which these wastes will demand when they are oxidized naturally under channel conditions in a stream or artificially in an activated sludge plant. The reason for this is found in the fact that the 5 day B.O.D. determination as carried out in the bottle test does not show any usage of oxygen in the oxidation of nitrogen and only up to about 68 per cent of that material usually termed "carbonaceous." Contact with oxidative sludge deposits in stream waters acts similarly to contact beds, trickling filters, and activated sludge, and the oxidations which take place in these stream waters probably carry a velocity constant of a magnitude more comparable with that of a trickling filter than that of a B.O.D. bottle.

The excess oxygen method as now used owes its origin to Frankland who in 1870 made attempts to study the pollution of the Thames River by incubating samples of the water over periods of time up to 7 days. Oxygen values were obtained at the beginning and end of the period selected by boiling off the gases *in vacuo*. Various procedures for measuring the usage of atmospheric oxygen have been employed since that time with improvements accruing up to the present procedure as found in *Standard Methods of Water Analysis*, 8th edition. Dr. E. J. Theriault, who has been largely responsible for the present technic as now used generally in the United States, in 1927 presented a comprehensive review [1] of the development of the B.O.D. test. Much of the early work was carried out under the leadership of Adeney and his associates of the Royal Commission on Sewage Disposal in England.

The mechanism of the test has been studied by many workers and early it was found that the presence of metabolizing microörganisms was a prerequisite of satisfactory performance. Thus Butterfield, Purdy, and Theriault [2] showed that, in a solution of peptone and glucose (5 p.p.m. each) in phosphate dilution water of pH 7.2, no oxygen would be used if this solution were incubated without inoculation with live bacteria; that dead *Aerobacter aerogenes* would likewise cause no usage of oxygen but that inoculation with live aerogenes organisms would cause marked usage of oxygen.

Inoculation of dilution water with a stale sewage or river water in those cases where insufficient organisms are present in the waste has become a rather common practice, though from a practical standpoint there probably are only a very few organic wastes which would not supply the inoculum if the bacterial food present were suitable for growth. The influence of inoculation on biochemical oxygen demand was studied by Eldridge [3] using sodium bicarbonate dilution water for the determination of the B.O.D. of dilute (0.1 per cent) sugar solutions. He showed that by increasing the inoculum of settled Imhoff tank effluent, progressively, after deducting the B.O.D. due to the added sewage, a progressively higher B.O.D. on the sugar solution was obtained up to the point where about 5 ml. of sewage was present in 250 ml. of sugar dilution.

Holderby and Lea,[4] working in our laboratory, repeated the work of Eldridge [3] but used *sterilized* Imhoff tank effluent in place of Imhoff tank effluent *unsterilized* as used by Eldridge. For inoculum Holderby and Lea used filtered washed cultures of sewage organisms which had been grown on agar. The initial count on the B.O.D. dilution was about 2,000 live organisms per ml. The results of these workers showed increases similar to those of Eldridge in B.O.D. values on the sugar dilution with increasing amounts of *sterile* sewage added and

with the inoculum remaining constant. This seems to show quite definitely that the progressively higher results which Eldridge found were not due to increased seeding but to some other factor or factors present in the sewage which he used for seeding.

Analyses of plain domestic sewage made in our laboratory have shown a total phosphorus content of about 4.0 p.p.m. and a total nitrogen content of about 30 p.p.m. The phosphorus and nitrogen content in the sewage used by Eldridge and described by him as "quite weak due to rainy weather" must have contained at least half these amounts or in the final dilution of 5 ml. of sewage to 250 ml. of sugar dilution as used by him, there would have been available 0.04 p.p.m. of phosphorus and 0.3 p.p.m. of nitrogen. These amounts correspond quite well with the amounts of these elements which Lea and Nichols [5] found necessary to add to plain sodium bicarbonate dilution water in order to obtain a B.O.D. on a 0.1 per cent solution of glucose of about the same magnitude as that obtained by Eldridge.

There is no doubt that seeding is required by certain types of wastes and also that it was required in the sugar solutions used by Eldridge,[3] but the author cannot agree with him that the effect shown was due to seeding but rather was due to the addition of supplementary mineral substances, notably phosphorus and nitrogen, present in the sewage used as the inoculum.

Lea and Nichols [5] obtained only a B.O.D. of 60 p.p.m. on a 0.1 per cent glucose solution using a dilution water seeded with sewage organisms containing 300 p.p.m. sodium bicarbonate, whereas when this water was supplemented with 0.02 p.p.m. phosphorus and 0.5 p.p.m. nitrogen a result slightly less than 500 was obtained on the same sugar solution. That these mineral supplements must be used when certain wastes are evaluated by the B.O.D. test is shown by the following experience:

A sewage plant superintendent in Wisconsin was contemplating the acceptance of the effluent from a process used to treat waste sulphite liquor, the "bug-bear" waste of the paper industry. This effluent was found to have a B.O.D. of about 400 p.p.m. by the procedure given in *Standard Methods of Water Analysis*, 8th edition. Before he made his final decision on the acceptance of the waste effluent to his plant he decided to mix this effluent with his domestic sewage and evaluate the mixture by the B.O.D. test. In short, he found that a mixture consisting of 1 part sulphite effluent and 4 parts domestic sewage gave the astounding B.O.D. of 900 p.p.m., whereas calculation of the mixture from the B.O.D.'s of the two separately showed that the mixture should have a B.O.D. of about 240 p.p.m. When the B.O.D. of the sulphite effluent was calculated from the result obtained from the mixture it was found to have a demand of 3,500 p.p.m. which, under the conditions imposed, *i.e.*, mixed with domestic sewage, must be considered the true B.O.D. of this effluent. A B.O.D. was determined by the author on a sample of this waste collected at a different time using *plain* bicarbonate dilution water inoculated with sewage organisms which had been washed free of phosphorus and nitrogen compounds, and the result found to be 550 p.p.m. Samples of this same waste set up at the same time with the remaining inoculated bicarbonate dilution water left in the 5 gallon bottle but supplemented with the mineral salts mixture [5] gave a B.O.D. of 4,235 p.p.m., a result nearly 8 times as great as with the bicarbonate dilution water of *Standard Methods*, 8th Edition.

The composition of this supplemented bicarbonate dilution water is given as follows:

| | | |
|---|---|---|
| Ammonium sulphate | 2.5 | p.p.m. |
| Tricalcium phosphate (anhy.) | 0.01 | " |
| Magnesium sulphate crystals | 0.01 | " |
| Dihydrogen potassium phosphate | 0.1 | " |
| Sodium bicarbonate | 300. | " |

in distilled water free from copper.

Results on other wastes showing the increased biochemical demands which are obtained with this dilution water are shown in Table I.

Stream waters [3] examined over widely separated areas contain amounts of phosphorus and nitrogen comparable with that present in this supplemented dilution water. These low nitrogen-phosphorus wastes will use oxygen from the stream in a manner comparable with that shown with the supplemented dilution water since the nitrogen and phosphorus for adequate

TABLE I

*Showing a Comparison of B.O.D. Values Using Plain Bicarbonate Dilution Water and This Water Supplemented by Mineral Salts Containing Both Phosphorus and Nitrogen*

| | *Results in p.p.m.* | | |
|---|---|---|---|
| *Type of Waste Examined* | *B.O.D. Values Using Plain Bicarbonate Dilution Water Standard Methods 8th Edition* | *B.O.D. Values Using Same Water Plus Mineral Supplement* | *Per cent Increase in B.O.D. Values Using Supplemented Water* |
| Glucose. 1,000 p.p.m. | 60 | 470 | 670 |
| Sulphite Waste Effluent | 550 | 4,325 | 685 |
| Domestic Sewage | 217 | 221 | 2 |
| White Water—Paper waste | 25 | 62 | 148 |
| Bleach Water—Paper waste | 30 | 148 | 390 |
| Black Liquor—Pulp waste | 480 | 1,450 | 200 |
| Pea Canning Waste | 940 | 893 | —5 |
| Beet Canning Effluent | 460 | 1,570 | 240 |
| Settled Sewage * | 135 | 140 | 4 |

* Results by Dr. W. D. Hatfield of Decatur, Ill.

It is seen from Table I that those wastes (sewages) which contain an adequate natural supplement of phosphorus and nitrogen give comparable B.O.D. values with the two dilution waters. Those wastes low in both nitrogen and phosphorus give much higher B.O.D. values when the supplemented water is used. A satisfactory reason for the low oxygen usage with plain bicarbonate dilution water on these wastes deficient in nitrogen and phosphorus is found in the absence of growth and multiplication of the bacterial flora in the B.O.D. dilution water.[5]

The question naturally arises—why do we want high B.O.D. results on these low nitrogen-phosphorus wastes? bacterial growth will be furnished by the stream water. The supplemented dilution water is simply giving a true picture of what may be expected when these low phosphorus-nitrogen carbonaceous wastes enter stream waters. The evaluation obtained with plain bicarbonate dilution water of the 8th edition of *Standard Methods of Water Analysis* on these wastes will fall far short of the actual demand. Yet this supplemented water gives comparable results with the plain bicarbonate water on domestic sewage. Criticisms have been made that the supplemented water, containing ammonium sulphate, would cause a usage of oxygen due to this salt. Experiments on this aspect of the problem as published [5] have shown

practically no production of nitrite or nitrate within the 5 day period and not sufficient in amount up to 30 days to influence the B.O.D. result greatly. Transference of the free ammonia nitrogen to organic nitrogen was noted in all cases, which seems to prove that the nitrogen used is entirely for bacterial cell growth.

Biochemical oxygen demand tests are used with impunity on all types of wastes to get a result. Very often little thought is given to the usefulness of the result obtained. Wastes high in free ammonia and organic nitrogen frequently will not give as high a B.O.D. value as similar wastes lower in nitrogen, yet these high nitrogen wastes will require much more oxygen from an activated sludge treatment process if the sludge is of the nitrifying type. Activated sludges of the nitrifying type are more apt to be present if wastes high in nitrogen are continuously presented for treatment. In these cases, evaluation of the high nitrogen waste should be made partially on the basis of B.O.D. with the added load calculated from the excess of nitrogen shown. Such a condition is found in a municipality in which a packing-house waste is treated with domestic sewage. Ammonium salts such as may be present in a gas plant or coke oven waste may increase the load on these plants far above that shown by a B.O.D. value. Dr. Clair N. Sawyer, working in this laboratory, has shown that ammonium chloride equivalent to 36 p.p.m. nitrogen was capable of extending the maximum rate of oxygen usage of a nitrifying type of activated sludge-sewage mixture from a normal time of about 2 hours up to slightly more than 5 hours with a total usage of oxygen double that of sewage alone before a base rate of the sludge for sludge re-use was obtained.

Substances inhibitory to bacterial growth such as copper in the dilution water have been known for some time to have a retarding effect upon the B.O.D., but this has not been generally appreciated. Amounts of copper sulphate as low as 0.5 p.p.m. were found by Stovall and Nichols [6] to be inhibitory to growth of bacteria in swimming pool waters. That small amounts of copper can cause appreciably lower B.O.D. results was emphasized to the author a short time ago. An industrial plant was required by the sewage authority to reduce the pollutional strength of their waste to the strength of domestic sewage both as measured by B.O.D. Checks on B.O.D. results between the industry concerned and the sewage authority could not be obtained.

Our laboratory entered the picture to help iron out reasons for the continual discrepancy—the industry obtained results invariably 25 per cent lower than the authority. Our laboratory results agreed quite well with the sewage authority. Every detail of the various steps in the procedures from temperature control to reagent standardization was investigated without finding the cause for the discrepancy. The chemist from the industry's laboratory did his work in our laboratory and checked our results and those of the authority. He was also able to use our distilled water in his laboratory and get comparable results. It was then suggested that he test his distilled water with sodium diethyldithiocarbamate for traces of copper. This element was found to be present to the extent of about 0.36 p.p.m. Replacement of a copper valve on the distilled water tank with one made of aluminum solved the difficulty. The B.O.D. values which had been running 25 per cent low were now comparable with those results of other laboratories.

If the use of the B.O.D. test is to be extended beyond the realm of sewage testing for which it was

originally devised, so as to include diverse wastes, attention will need to be given to all conditions of bacterial growth in the B.O.D. test bottle. Not only must toxic and inhibitory substances be excluded from the test bottle, but adequate non-oxygen using minerals of cell metabolism be provided, either by the waste or in the dilution water; otherwise the test falls short of its "biochemical" name. The present plain bicarbonate dilution water as recommended by the 8th edition of *Standard Methods of Water Analysis* of the American Public Health Association is satisfactory for the B.O.D. determination on domestic sewage and its effluents, because these carry their own supplements of nitrogen and phosphorus, but this dilution water is wholly unsatisfactory for this determination on carbonaceous wastes low in soluble phosphorus and nitrogen.

B.O.D. results cannot be expected to give the entire picture of what effect a given waste will have upon a stream, but they should evaluate each waste on a comparable and equitable basis so that the true strength of these wastes and their expected effect upon a stream or receiving water can be known as fully as possible. The addition of the supplements of phosphorus and nitrogen to the present bicarbonate dilution water of *Standard Methods* does not in itself cause a usage of oxygen but provides conditions as found in stream waters for natural biological growth which is admitted by all workers to be the basis of the B.O.D. test.

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# Use of the Marginal Punch Card in Tabulating Vital Statistics Data*

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IN 1936, with the expansion of the public health program through funds made available by the passing of the Social Security Act, our division was enabled to employ the services of a trained statistician. Our limited legislative budget, however, prohibited the expenditure necessary for rental of mechanical tabulating and sorting equipment used in most state vital statistics offices.

It was at that time that we learned by chance of a system said to accomplish essentially the same results as mechanically operated machinery by the use of an ordinary hand punch and knitting needle, the installation of which entailed practically no expense aside from the cost of the cards.

Somewhat dubiously we visited the office of one of the West's largest department stores and were shown a system of unit stock control operated entirely by the punch card method. Our further study of the problem convinced us of its possibilities as applied to our own needs and we then and there embarked upon the experiment of adapting the marginal punch card, for the first time in a state health department, to the tabulation of vital statistics data.

It is interesting to note that, although the first patent was issued in 1896, it was not until 1920 that the marginal punch card was used to practical advantage by Dr. Alan Gregg, who conceived the idea of using individual survey cards in tabulating the results of a hookworm survey in Brazil. He experimented with cards upon which information was coded by cutting notches around the border by hand with scissors. For group separation these cards were placed against the sharp edge of a ruler which fitted into the notches and forced the unnotched cards to a higher level. The separation was then made by picking out the unnotched cards.

A few years later Drs. Hackett and Soper adapted essentially the same system to other disease surveys, this time using a punch which "bit into the margin of the card, transforming the hole into an open notch." Rods or wires were run through a pack of such cards at any of these holes, whereupon the notched cards would fall out, while the others would remain suspended.

In the meantime the system has been developed, improved, and perfected to meet the requirements of every type of statistical analysis. It is seemingly so

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versatile that it can be applied to any number of diversified procedures with equally successful results.

The card originally used in our Division of Vital Statistics was 4 by 6 inches in size and provided for the coding of practically all the data contained on the mortality certificate.

During a year's experimenting we naturally discovered that certain improvements could be made. The original codes were revised slightly and the size changed to 3¼ by 7⅜ inches, the standard size tabulating card, which we find considerably easier to handle. Our present card contains 90 holes—five to the inch—and provides for over 800 separate classifications. Causes of death are coded on the card according to the *International List*, and all classifications, including the sub-letters, and the sub-numbers under each letter, can be punched in 17 holes.

Cards can be divided and subdivided into all possible groups at the rate of about 5,000 an hour by means of a rod or sorting needle inserted into the holes in succession. The rod will lift out all cards not fulfilling the given condition and there is no necessity of reading the cards or dealing them one by one into piles.

The upper right hand corner is cut off so that it can be seen at a glance whether all cards in the pile are correctly arranged.

Errors in group distribution can be detected at once in piled cards, since each group should present an unbroken line of slots at a given point on the margin. Groups can also be placed together without confusion, since this marginal slot serves to distinguish one from another.

Where the data are broken down into small divisions—for example, infant deaths into hours, days, weeks, months, etc., the process of elimination requires considerable manipulation and the operation cannot be accomplished as rapidly as would be possible with a mechanical sorter. On the other hand, where only a direct sort is needed, such as the separation of males from females, single from married, or whites from colored, only a single operation of the needle is required and the cards separate themselves into two distinct groups in less time than a machine can be put into operation.

While the necessity of hand counting might be a disadvantage in state offices where great numbers of records are tabulated, it presents no problem in a small state, since after the cards are broken down according to the data needed, the groups are relatively small and can be counted quickly.

In addition to the information actually punched, there is the information conveyed by the ABSENCE of punching. For instance, most deaths in Utah are of whites, so unless the decedent is colored, no punch is necessary. The same applies to male sex, nativity in state, and deaths occurring in homes. A card containing 90 holes may be punched in as few as 9 places and still mean just as much statistically as though the majority of the holes were cut.

The marginal punch card may be drawn up to fit the needs of any type survey, with as little or as much information as may be desirable. At the present time three separate divisions of our State Health Department are now applying the system to their own programs, all on cards of different size and shape.

With the development and growth of our full-time district and county health units the punch card system of tabulating will undoubtedly find its way into the field office. The financial impracticability of elaborate machines for handling such work in the local health units is at once apparent.

There is the possibility, too, of having the operator in the central office

punch two cards simultaneously, the duplicate to be forwarded to the district or county office where it applies.

Under some conditions it may be advisable to use the cards as an index. In this case the card should carry spaces for typing the name, age, file number, and any other data which cannot be indicated by punching. However, when the card is used, not as an index, but as an auxiliary for tabulation only, it need carry only the serial number for identification.

The system is so obviously simple that a person with average intelligence can become a proficient operator in a very short time. As many operators as may be needed can punch or sort at the same time, which is a distinct advantage, especially at peak load periods when special reports must be rushed through by given dates. Punches and sorting needles are available for use at all times and there are no mechanical devices to get out of commission, thereby delaying the work.

To summarize the advantages of the punch card system:

1. It is practical and inexpensive.
2. It can be used anywhere in the field.
3. It is flexible and can be adapted to any type of survey and to any size card.
4. It is accurate. Possible errors in punching are obvious.
5. It is simple in principle and requires no special training on the part of the operator.
6. It is speedy and any number of operators may work simultaneously. Delays are obviated in that there is no machinery to get out of order.

# Districting New Mexico for Sanitation*

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THERE are 31 counties in the State of New Mexico with a total area of 122,503 square miles. The population is approximately 3 per square mile. However, there are many square miles that are uninhabited.

Prior to the adoption of the Social Security Act there were only a few of our counties financially able to maintain full-time health units. The majority of the counties maintained a part-time health officer and in some instances, a public health nurse was employed. With the possibility of securing considerable outside financial aid, study was given to the advisability of placing the entire state under full-time local health service. This was accomplished by the adoption of the District Health Act which divided the state into ten health districts. There are from two to four counties in each health district. The division was made on a population basis and on the ability to pay. The districts have approximately 50,000 people each but the area involved varies from 5,000 square miles to 24,000 square miles. The average is about 12,000 square miles.

The executive is the district health officer, who is employed on a full-time basis. In addition there are employed in each county at least one nurse and a clerk for the county health department.

Prior to the adoption of this Act the engineering division consisted of one sanitary engineer and a secretary. It was impossible to give close attention to the many sanitary problems which arose in the various communities throughout the state. About all that could be done was to maintain reasonable supervision over public water supplies, sewerage systems, and to a limited extent over milk supplies.

With Social Security funds a trained sanitarian has been placed in each of the ten health districts. Some of our men are graduate engineers who have received supplementary training in sanitation, but the majority of them have received other types of basic education. All but one are college graduates, and he has had 3 years of medicine.

The functions performed by these district sanitarians are basically the same as those performed by the sanitary officer in any full-time health unit. Restaurant and food sanitation, milk supplies, investigations of nuisances, and school sanitation consume most of their time.

In the larger cities we have been successful in getting the community to employ city sanitarians in order to relieve the district men of the burden of milk inspections, etc. In order to supplement the services of district and

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city sanitarians the State Health Department has recently employed a Milk Sanitarian whose services are available to the district units and to the cities.

Observations regarding the wisdom of such a districting plan have been very encouraging. Trained personnel is available for the routine work and the investigation of complaints. Much progress has been made in the improvement of market milk supplies and general sanitation. The district sanitarians are invaluable in the promotion and operation of the WPA Privy Project.

One district health officer recently made the statement: "If we had as many sanitarians as we have nurses, we could really do something about our high infant mortality rate."

So far we have been so encouraged with the district plan that it is our purpose to add additional county sanitarians as soon as funds are available.

# Effects on Health of Gases Produced by the Electric Arc*

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IN view of the quantity of work done recently on the electric arc and the possible toxic effects of inhalation of the products of arc combustion, a review of the work would seem timely.

Because of his interest in ventilation and air conditioning problems, Dr. E. L. Mac Quiddy of Omaha prompted the Nebraska State Labor Commission to make a survey of the motion picture projection booths in the state. The Commission did this and besides ran some experiments with the arc itself. The results of their study were published in 1936.[1] They found that oxides of nitrogen were given off by the electric projection arc and they stated that there was a possibility of the oxides of nitrogen reaching disagreeable, if not toxic, concentrations in poorly ventilated motion picture projection booths. They stated further that an investigation of the booths in the state showed that most booths could be classified as poorly ventilated.

Fellowships were set up at the Harvard School of Public Health and at the University of Nebraska College of Medicine for the purpose of determining the combustion products of the arc, the effects of inhalation of the arc fumes, and the proper methods of ventilation of rooms where arcs are used. Some of the results of these investigations were published in the April, 1938, issue of the *Journal of Industrial Hygiene*. More are to follow.[2]

## EXPERIMENTAL

The main apparatus, used in the study of the arc fumes and their effects, consisted of an arc lamp of latest design and in common use in motion picture projection booths. The lamp was operated on direct current of from 40 to 55 amperes and 28 to 36 volts. The electrodes were high intensity 7 mm. positive, and 6 mm. negative copper coated carbons. Fumes from the arc were exhausted by means of a 5 inch flue attached to connections provided on the lamp house. A fan was arranged to draw a current of air through this flue system and discharge it out of doors. The fumes, after leaving the arc housing were conducted through a cooler to bring the temperature to 25° to 28° C. before passing to the animal's exposure chamber, which chamber was inserted in the exhaust flue line. In later experiments this apparatus was modified by inserting a filter in the flue line to take out the particulate matter in the arc fumes. Another piece of apparatus was a

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specially constructed chamber in which animals were exposed to the particulate matter, devoid of the gases, arising from arc combustion.

Air flow through the arc apparatus varied from 3.8 to 9.4 cu. ft./min. In analysis of the fumes both gaseous and particulate matter were encountered. Oxides of nitrogen and carbon dioxide were collected in Orsat tubes containing the proper absorbents and at flows of approximately 10 liters per hour. The phenoldisulphonic acid method,[3] as well as the liquid air nitron method,[4] was used for the analysis of the oxides of nitrogen. Under the conditions described concentrations of $NO_2$ from 100 to 205 p.p.m., expressed as $NO_2$ at 25° C. and 760 mm. pressure, were obtained in the exhaust flue.

Under the same conditions, using the method of Fieldner,[5] concentrations of 2,450 to 2,770 p.p.m. of $CO_2$ expressed at 25° C. and 760 mm. pressure were obtained. No sulphur dioxide, carbon monoxide, or ozone could be detected by standard methods of analysis.

TABLE I

*Chemical Composition of Ash from the "Suprex" Carbon Arc*

| *Substance* | *Sample 5,222* *Per cent* | *Sample 5,223* *Per cent* |
|---|---|---|
| Silicon dioxide | 1.79 | 1.21 |
| Rare earth oxides | 65.70 | 71.80 |
| Ferric oxide | 2.26 | 1.46 |
| Calcium oxide | .53 | .20 |
| Potassium oxide | 2.26 | 2.38 |
| Sulphur trioxide | 2.35 | 2.98 |
| Phosphorous pentoxide | .17 | .15 |
| Fluoride | 10.65 | 11.31 |
| Boric anhydride | .50 | .60 |

All samples contained a small amount of copper. A suspension of 5,222 in distilled water showed a pH of 5.5. All samples contained some unburned carbon and 5,223 a small amount of manganese. The rare earth substances are for the most part combined with fluoride, the compounds being extremely insoluble in water. The calcium is probably combined with the sulphate.

The particulate matter in the arc fumes on chemical analysis revealed the composition of the ash (Table I).[6]

The specific substances comprising the rare earth oxides mentioned in Table I and their relative proportions are as follows:

| | *Per cent* |
|---|---|
| Cerium oxide | 46 |
| Lanthanum oxide | 22 |
| Neodymium oxide | 22 |
| Praseodymium oxide | 8 |
| Samarium oxide | 3 |

Light field examination showed this ash to be composed of particles or agglomerates of particles in which 79 per cent of the particles were 1.5 to 0.75 microns in diameter. The concentration of ash in the exhaust flue varied from 3.5 to 5.3 mg./cu. ft.

Several groups of animals were subjected to various conditions of exposure to the arc products. In all cases animals were subjected to the highest concentrations of arc substances which were possible to attain with the apparatus used. The pathological physiology of the animals was studied by erythrocyte count, leukocyte count, Ehrlich and Schilling differential counts, hemoglobin, NPN, blood sugar, $CO_2$ combining power of the blood plasma, icterus index, blood spectrum, and body weight. Upon the death of every animal histopathological studies were made upon microscopic sections of the viscera.

During the course of the study the various conditions of exposure to the fumes were:

1. Exposure to gross arc fumes (gaseous and particulate matter). Acute and chronic exposure.
2. Exposure to filtered arc fumes (gaseous matter only, ash filtered out). Acute and chronic exposure.
3. Exposure to the ash alone.
4. Exposure to concentrations of $NO_2$, generated from copper and nitric acid, simulating the concentration range found in the arc flue.

In the group subjected to acute con-

tinuous exposure to gross arc fumes were 14 animals, including mice, rats, guinea pigs, rabbits, and cats. Twelve of the animals were dead in from 1 to 22 hours. The animals showed the spectrum of methemoglobin in their blood samples, and a lung edema clinically and microscopically. The guinea pigs showed a polymorphonuclear leukocytosis, and in those two surviving, the leukocytosis subsided in a week. There were no residual lung changes in the two animals surviving.

In the group subjected to chronic exposure to the gross arc fumes there were 5 rats and 5 guinea pigs. These animals were exposed for 1 hour per day 6 days a week to the fumes. Of these animals all 5 of the rats died in from 11 to 38 weeks, showing various stages of acute, sub-acute, and chronic inflammatory processes in their lungs. Of the 5 guinea pigs none died in a period of 10 months' exposure. Their blood samples showed no changes, the lungs showed no changes, and the animals gained weight.

Another group of animals was exposed for 4 hours per day, 6 days a week, to the gross arc fumes. Nine rats and 12 guinea pigs were included in this group. Of the 9 rats all were dead in from 1 to 16 weeks, showing various stages of acute, sub-acute, and chronic pneumonitis with fatty degeneration, abscesses, and gangrene. Of the 12 guinea pigs 11 died in from 2 to 8 months. The average weight loss before death was 100 gm. Each animal showed a polymorphonuclear leukocytosis at death. There was a terminal rise in NPN and a drop in $CO_2$ combining power of the blood plasma. All animals showed the spectrum of oxyhemoglobin in their blood samples. Histologically the animals showed acute paranasal sinusitis, patchy atelectasis, pneumonitis, fatty degeneration, and dust phagocytosis in their lungs. There were fatty changes in the livers.

The same types of exposure were repeated, but the particulate matter was filtered out of the fumes by the combined use of an oiled spun glass filter and a felt filter. To these filtered fumes, consisting of the gaseous elements of combustion, 12 guinea pigs were exposed 4 hours per day for 7 months. In from 1 week to 7 months 6 of the animals died, showing pneumonitis, patchy atelectasis, and a very few dust phagocytes. Their blood samples showed terminally a polymorphonuclear leukocytosis, increased NPN, and decreased $CO_2$ combining power of the blood plasma. There was a loss of from 43 to 166 gm. in weight for each animal in from 1 to 5 weeks before death.

Ten rats were exposed 4 hours per day to the filtered arc fumes. All 10 were dead in from 1 to 4.5 months' exposure. Sections of the lungs showed pneumonitis, abscesses, a very few dust phagocytes, and an hyperplasia of the lymphoid tissues.

Ten animals, including mice, rats, guinea pigs, and rabbits, were exposed acutely and continuously to the filtered arc fumes. Eight of the animals were dead in from 2 to 22 hours, showing methemoglobinemia and lung edema.

The findings in the animals subjected to the filtered fumes were identical with those findings in the animals exposed to the gross arc fumes except in the latter there were many dust phagocytes.

In order to compare the effects of inhalation of arc fumes to the effects produced by the inhalation of small quantities of pure $NO_2$ a group of animals was exposed to $NO_2$ generated from copper and nitric acid in a concentration range simulating that in the arc exhaust flue. Twelve guinea pigs were exposed 4 hours per day to $NO_2$ in a concentration range of from 100 to 200 p.p.m. All the animals died in from 3 weeks to 7 months, showing pneu-

monitis, atelectasis, and emphysema. The animals showed a terminal polymorphonuclear leukocytosis, an increased NPN, a decreased $CO_2$ combining power of the blood plasma, and an average weight loss of 71 gm. in from 1 to 4 weeks. Ten albino rats were exposed in the same manner. All died in from 1 week to 4 months, showing lung edema, pneumonitis, and patchy atelectasis.

Several of the commonly accepted laboratory methods of determining the effects of dust on animals were used in this study. Exposures to silica, talc, bituminous coal, iron oxide, carbon, and orris root were concurrently made as controls, while exposures to Suprex arc ash, Suprex core material, and mixtures of therapeutic and industrial carbon arc ash were made to determine the comparative effects of the arc dusts.

The methods of exposure included actual inhalation of Suprex arc ash in a dusting chamber. Concentrations of the dust varied from 12.8 mg. to 24.7 mg. per cu. ft.; 79 per cent of the particles were 0.5 to 1.5 $\mu$ in diameter. Definite changes were observed in the lungs, but detailed study has not been completed.

Another group of 50 rabbits was given intratracheal insufflations of the various dusts according to the method suggested by Kettle and Hilton.[7] The dosage was 0.2 gm. in 2 cc. of sterile saline. X-rays of the chests of these animals were taken at 7 months and 10 months following insufflation. The animals were killed at 12 months after the initial insufflation at which time sections of the viscera were made for micropathologic study. This work has not been completed to the extent of drawing definite conclusions.

Subcutaneous injections of the various dust samples were made on the same rabbits receiving the intratracheal insufflation. The same dosage of 0.2 gm. of dust in 2 cc. of sterile saline was used. Sections of the subcutaneous lesions produced were made upon the deaths of the various animals.

Intraperitoneal injections of the various dusts were made into rats following the technic of Miller and Sayers.[8] Animals were killed at 15-30-60-90-200-360 days and sections were made of the viscera and the abdominal lesions produced. In like manner this study is not completed to the point of drawing conclusions.

## DISCUSSION

Various modifications of the electric arc are used under such conditions as motion picture projection, photoengraving, treating with ultra-violet and infra-red lamps, flood lighting with search lights, and electro-welding. Titus, *et. al.*[9] in 1935 called attention to the respiratory hazard occurring in electric welding. In most of the conditions mentioned the arcs are used in a closed space, and frequently a small closed space. Emphasis is placed on the fact that it is in those conditions of use of an arc in a small closed space without adequate ventilation that dangers from inhalation of the fumes of combustion arise.

The electric arc was discovered in 1812 by Sir Humphrey Davey. Shortly thereafter Cavendish discovered that the oxides of nitrogen were formed around the electric arc. The chemical process by which such a formation takes place has been well explained since today the arc process is one of the commercial methods of nitrogen fixation. The reactions which take place as the arc burns are [10]:

$$N_2 + O_2 + 43{,}200 \text{ gm. cal.} \rightleftarrows 2\ NO$$
$$2\ NO + O_2 \rightleftarrows 2\ NO_2 + 13{,}900 \text{ gm. cal.}$$
$$2\ NO_2 \rightleftarrows N_2O_4$$
$$2\ NO_2 + H_2O \rightleftarrows HNO_3 + HNO_2$$

The credit for having made the first observation that the concentration of the oxides of nitrogen might reach toxic levels when electric arcs are being

used should go to Dadlez, a Parisian physician, who in 1927 wrote that the concentration of oxides of nitrogen reaches levels which cause headache in operators and patients in rooms where electric arcs are used for infra-red and ultra-violet therapy.[11]

Considering the results of the various types of animal exposures as a whole, the findings in the gross fumes exposure group, the filtered fumes exposure group, and the pure $NO_2$ exposure group, strongly suggest that the oxides of nitrogen play the chief rôle in producing the evil effects of inhaling arc fumes.

The figures of Lehman and Hasegawa as to the levels of toxicity of $NO_2$ seem to be generally accepted. These concentrations are calculated as $NO_2$ at 0° C. and 760 mm. pressure.[12]

| | *p.p.m.* |
|---|---|
| Allowable concentration | 39 |
| Allowable one half hour | 78 |
| Directly dangerous | 117 to 156 |
| Rapidly fatal | 780 |

The concentration range of $NO_2$ in the exhaust flue is well within this danger level as given by Lehman and Hasegawa. Coltman[13] writes that on the basis of calculation a high intensity lamp in an unventilated room of 1,000 cu. ft. will bring the concentration of NO (nitric oxide) to 125 p.p.m. in 11 minutes. While with a white flame carbon arc using 1,400 watts, over 2 hours would be required to attain this level. These calculations are based on the assumption that no ventilation at all would occur.

Henderson and Haggard,[14] Ireland,[15] Winternitz,[16] and Underhill[17] have contributed considerably to the knowledge of the effects of inhaling irritant gases. The findings of lung edema in acute exposure, and various lung inflammatory conditions in chronic exposure to the arc fumes fit in with the current knowledge of the effects of exposure to the group of irritant gases of which $NO_2$ is a member.

The methemoglobin found in the blood samples of the animals acutely exposed to the arc fumes results from the action of $NO_2$ on the moist mucosa of the lung in which reaction nitric and nitrous acids are formed. The nitrite ion is absorbed into the blood stream and its action on the hemoglobin causes the formation of methemoglobin. The nitrite ion may also cause a drop in blood pressure with resultant cerebral anemia. This latter action could explain the clinical condition of headache in persons exposed for too long a time to too great a concentration of the arc fumes. However, such a concentration could not be reached in properly ventilated projection booths.

The lung edema which occurred in those animals acutely and continuously exposed to the arc fumes results from injury to the capillary walls by the irritant gas with a resultant physiologic outpouring of fluid into the alveolar spaces. Wells[18] says that this fluid is practically the consistency of blood plasma.

The chronically exposed animals showed various findings in regard to pathological physiology consistent with chronic inflammatory disease of the respiratory tract and resultant loss of appetite and starvation. These findings were an increased NPN, a decreased $CO_2$ combining power of the blood plasma and a loss of weight.

The results of these studies and similar reports indicate the need for considering the conditions under which electric arcs are operated. There is no basis for criticism of those operating conditions in which there is an exhaust flue in which forced ventilation is in use to remove the products of combustion no matter what the conditions of use are. However, there is danger in inhaling fumes coming from an improperly ventilated arc.

Very recently there appeared in the *Monthly Labor Review*[19] a summary of a survey of the safety standards for motion picture machine operators in 186 cities in the United States having a population of 50,000 or over. one hundred and four of the cities had no laws as to the number or size of ventilation inlets of projection rooms. Ninety-five per cent of the cities had some requirement that systems should be vented to the outer air, but only 19 had definite specification as to area or diameter of vents in relation to room size, number of lamps, or number of men working. The results of the survey show that detailed requirements as to equipment to be used and methods of ventilating the projection room proper and the lamp house connected with the machine are not general. The cities of Hartford, Conn., St. Louis, Mo., and Philadelphia, Pa., as well as the States of Indiana and New York are the only ones that have definite requirements in regard to the system of lamp house ventilation.[20]

In Hartford, Conn. the 1936 law states that the booth air must be changed at the rate of 30 cu. ft./min. The arc lamp housings must be vented to the outside air and must be provided with automatic shutters.

The St. Louis Law adopted in 1937 states that "each lamp house where carbons are used shall have an independent forced ventilation system of sufficient size to carry off independently of the booth ventilation, all fumes, carbon dust, and carbon monoxide gas generated in the lamp houses while in operation."

In Philadelphia a complete system of direct lamp house ventilation is required in all booths. The system must consist of a motor operated fan, which fan is connected in the booth lighting circuit so that it will switch on and off with the booth lights. The flue must be able to draw not less than 200 cu. ft. per minute per lamp. On spot lights or other projection equipment where the lamp house must be free to move, the exhaust duct is required to terminate in a hood above the machine, and the flue leading from the hood must discharge out-of-doors. Both the lamp house exhaust fan and the general booth exhaust fan are required to have separate sheet metal discharge ducts to the outside air.

In Indiana the state law requires that all arc lamp housings must be connected to the booth ventilation system.

In New York it is required that the arc lamp house of the machine be provided with a chimney and damper which shall carry off the products of combustion in the arc housing to the outside atmosphere.

Drinker and Snell[21] recommend that the flue pipe from each projector lamp be ventilated at a minimum rate of 12 c.f.m. and that the booth be connected to the air conditioning system of the theater, or else ventilated at a sufficient rate to maintain comfortable temperature with relation to the outside air.

The ventilation system should be a forced one and the fan should be so wired that when the arc is struck the fan turns on automatically.

## CONCLUSIONS

It may be concluded from these experimental studies that:

1. There are gaseous and particulate products of arc combustion. The oxides of nitrogen are the main toxic gaseous substances present. The ash is approximately 65 to 70 per cent rare earth substances, especially insoluble Cerium oxides and fluorides. The ash is composed of particles or agglomerates of particles for the most part 1.5 $\mu$ in diameter or smaller.

2. The concentration of the oxides of nitrogen in the exhaust flue of a

projection arc is within the range of toxicity if the undiluted fumes are inhaled.

3. Inhalation of the gross and filtered arc fumes, occurring in concentration ranges as exist in the arc exhaust flues, causes the death of common laboratory animals exposed acutely and chronically. Acute exposure results in a methemoglobinemia and lung edema, and chronic exposure results in a pneumonitis, showing patchy atelectasis and chronic inflammatory changes in the respiratory tract.

4. The main conclusions that may be drawn from Drinker's work are that each projector lamp should be connected to a flue in which the fumes from arc combustion are exhausted by means of a motor driven fan to the out-of-doors. The fan should turn on automatically as the arc is struck and the exhauster should draw from 12 c.f.m. to 100 c.f.m. In general it may be said that if ventilation in the booth is adequate to give a comfortable working temperature in the projection room, there is no danger of the toxic gases produced by the electric arc reaching disagreeable concentrations.

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## DISCUSSION

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IN the case of poisoning from fumes from the carbon arc, as with many other public health problems, there are two sorts of things necessary for the solution of the problem involved. One of these is the securing through experi-

mentation and observation of the necessary scientific knowledge; the other—the part that so frequently lags in the case of public health problems—is the application of that knowledge to the solution of the problem.

La Towsky's paper deals especially with the scientific part. That nitrogen is "fixed" by the electric arc and that the resulting compounds are toxic, has long been known. That an important industrial hygiene problem in connection with the use of the electric arc existed was recognized by the Nebraska State Labor Department in 1935, and some experiments to illustrate the necessity of adequate ventilation in motion picture projection rooms was done by the Nebraska (state) Health Department. Personnel of the Labor Department were shown experiments in which guinea pigs were exposed to fumes from the arc, and thereby the personnel was impressed with the importance of ventilation in connection with the use of the arc. At the conclusion of a series of such experiments a letter for the Labor Department records was written as follows:

Mr. V. B. Kinney
Labor Commissioner
State Capitol
Lincoln, Nebraska
Dear Sir:

Following information from you of a number of cases of chronic illness occurring among motion picture operators employing the carbon arc light for illumination purposes, some of these cases having been tentatively diagnosed as carbon monoxide poisoning, and at your suggestion that the laboratory aid in attempting to determine the nature of poisonous fumes emanating from the carbon arc light, some experiments were undertaken which will be discussed in the paragraphs to follow.

An apparatus was arranged to collect the fumes from above the carbon arc and cause them to pass through an enclosed glass chamber at a regular uniform rate. Guinea pigs exposed to such fumes in this chamber showed restlessness and irritation beginning a few minutes after exposure had started and progressing with increased intensity, the animals staggering around until at the end of 45 minutes to 1 hour the animals so treated were unable to stand any longer. They were then removed from the chamber and a rapid recovery of the animals to apparently normal state followed.

An absorption train designed to absorb nitric oxide but to permit the passage of carbon monoxide was introduced between the carbon arc and the glass chamber. Tests for nitrites showed that this absorption train did not remove all of the nitric oxide gases but indicated that the amount of such gases reaching the chamber were considerably reduced. Guinea pigs exposed to the fumes in this chamber following such absorption showed no signs of irritation or toxicity at the end of 1½ and 3 hours' exposure respectively.

Spectroscopic examination of the bloods taken from these two series of experiments were made immediately following the experiment. The spectroscopic appearance of the blood from the animal exposed to the unaltered fumes showed an abnormal spectrum identical in appearance with the spectrum of some blood to which had been added a small amount of sodium nitrite. Spectrum of the blood from the other series showed identical with normal blood. No spectroscopic evidence of carbon monoxide poisoning could be found in the blood of animal so exposed.

The fact that nitrogen oxides are produced by the arc and that these oxides are toxic is not new knowledge. However, these brief experiments illustrate the importance of adequate ventilation to prevent exposure of workers to the fumes from the arc. The experiments conducted showed definite evidence of considerable toxicity resulting from the nitric oxides but showed no evidence of other poisonous substances in the fumes from the carbon arc light.

Respectfully yours,
L. O. Vose
Director of Laboratories
(State) Department of Health

La Towsky's experiments took up the scientific problem at about this stage and amplified and extended the scientific knowledge in an able manner. Especially interesting is the fact that certain species of animals were found to be much more sensitive to arc fume than were other species—a fact suggesting that there might be considerable differences in individual susceptibility

among humans. The work he has started on the composition and possible harmful properties of the dust from the arc should be completed and should be extended to include the various types of therapeutic carbons being used.

I understand these experiments as well as other of this nature have been conducted with ordinary atmosphere as present in the respective laboratories—probably atmospheres low in humidity and in carbon dioxide. These experiments found no evidence of carbon monoxide formation. The atmosphere of a small motion picture booth might be considerably different, containing higher concentrations both of moisture and carbon dioxide. It would be interesting to know what changes, if any, would occur to these compounds in the arc say in an atmosphere containing 2 per cent carbon dioxide with a high relative humidity.

The other part of the problem, that of securing adequate ventilation where arcs used in occupied rooms, will depend on educational and regulatory measures and the enforcement of the latter by labor departments, health departments or other organizations—largely governmental—that have to do with promulgating and enforcing regulations relative to safety and health in the industries.

Those engaged in such enforcement have found that the providing of suitable ventilation facilities is not sufficient. Inspection at intervals to check on repair and proper operation is also necessary. Instances are known where ventilation fans have been operated in reverse so as to cause arc fumes to be blown back on the operator in motion picture booths.

At one time a great many arc lights were used as sources of heat and ultraviolet radiation used for therapeutic purposes. Some of these were used in physicians' offices and others in private homes. It is probable that in most instances of use, ventilation was adequate. However, it could do no harm for those selling carbons for these arcs to accompany the merchandise with suitable cautions or information as to the toxic nature of the fumes.

This organization, The American Public Health Association, has, through its various committees and subdivisions, recommended standard practices covering many subjects of public health importance. It seems to me that the Industrial Hygiene Section could draw up standard recommendations covering this subject as they probably have covering other subjects of importance in securing safety in industry, these recommendations being suitable for adoption and use by the various agencies dealing with industrial hygiene in those places where the carbon arc might be a health hazard.

# A Comparative Study of the Mouse and Guinea Pig Inoculation Methods in the Diagnosis of Rabies*

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PUBLIC health officials in many parts of this country report an increase in the prevalence of rabies in animals. The possible consequences in man are quite generally recognized. From an unpublished survey we have compiled a 5 year tabulation of rabies examinations in 10 municipal public health laboratories (Table I) which shows an increase in the number of such examinations in several of these cities.

There is a distinct need for improved methods in the laboratory diagnosis of rabies as well as the establishment of certain generally acceptable standards.

In view of the recent experiments of Webster and his associates [1, 2, 3, 4] a renewed study of the laboratory diagnosis of rabies is both desirable and timely. In the routine diagnosis of rabies one frequently observes that when guinea pigs are injected with material for diagnosis irregularities of incubation period are encountered, and frequently the animals survive the injections. The need for a more desirable test animal is obvious.

Despite reports [5] in which mice have proved unsatisfactory as test animals, the recent studies of Webster indicate that certain inbred strains of mice are highly desirable for diagnostic purposes. A diagnostic test by mouse inoculation was developed by Webster and Dawson [4] as an aid to the microscopic method. These investigators used a strain of albino mice indistinguishable from other mice except for their greater susceptibility to neurotropic viruses. The technic described by these investigators was only slightly modified in the present study. An approximate 10 per cent suspension of brain tissue from the central portion of the hippocampus major was made using salt solution as the diluent and larger clumps were removed by permitting them to settle in the mortar rather than by centrifugation. Throughout the entire study of guinea pigs received 0.1 cc. of the 10 per cent brain suspension intracerebrally while mice received 0.03 cc. When intramuscular injections were made 0.25 cc. of the suspension was introduced.

We might mention, however, that

* Read before the Laboratory Section of the American Public Health Association at the Sixty-seventh Annual Meeting in Kansas City, Mo., October 26, 1938.

TABLE I

*Five Year Tabulation of Rabies Examinations in 10 Municipal Public Health Laboratories*

(1931 to 1935 inclusive)

| *Municipal Public Health Laboratories* | | *1931* | *1932* | *1933* | *1934* | *1935* | *Rabid Animals* — *Average Yearly No.* | *Rabid Animals* — *Average Yearly Rate per 100,000 Population* |
|---|---|---|---|---|---|---|---|---|
| Louisville | P | 86 | 105 | 135 | 213 | 253 | 158 | 52 |
| | N | 89 | 93 | 109 | 151 | 135 | | |
| | T | 175 | 198 | 344 | 364 | 388 | | |
| Memphis | P | 156 | 117 | 113 | 115 | 145 | 129 | 46 |
| | N | 244 | 185 | 206 | 248 | 221 | | |
| | T | 400 | 302 | 319 | 363 | 366 | | |
| Los Angeles | P | * | * | 376 | 234 | 367 | 326 | 25 |
| | N | * | * | * | * | * | | |
| | T | * | * | * | * | * | | |
| St. Louis | P | 19 | 29 | 204 | 118 | 54 | 85 | 10.5 |
| | N | 71 | 97 | 221 | 158 | 168 | | |
| | T | 90 | 126 | 425 | 276 | 222 | | |
| Chicago | P | 45 | 42 | 11 | 23 | 227 | 70 | 2.0 |
| | N | 253 | 367 | 274 | 272 | 409 | | |
| | T | 298 | 409 | 285 | 295 | 636 | | |
| Detroit | P | 12 | 1 | 1 | 3 | 46 | 12 | 0.8 |
| | N | 139 | 90 | 94 | 97 | 126 | | |
| | T | 151 | 91 | 95 | 100 | 172 | | |
| New York | P | 58 | 18 | 26 | 44 | 20 | 33 | 0.4 |
| | N | 357 | 363 | 440 | 531 | 568 | | |
| | T | 415 | 381 | 466 | 575 | 588 | | |
| Baltimore | P | 14 | 0 | 0 | 0 | 0 | 3 | 0.4 |
| | N | 37(a) | 36 | 46 | 36 | 57 | | |
| | T | 53 | 36 | 46 | 36 | 58(b) | | |
| Washington | P | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | N | 0 | 0 | 0 | 0 | 0 | | |
| | T | 0 | 0 | 0 | 0 | 0 | | |
| Milwaukee | P | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | N | 0 | 0 | 0 | 0 | 0 | | |
| | T | 0 | 0 | 0 | 0 | 0 | | |

P = Rabies positive; N = Rabies negative; T = Total number of examinations.
(a) = 4 doubtful reports; (b) = 2 brains reported unsatisfactory.
* = No information available.
NOTE: The data contained in this table were taken from a previously unpublished study.

impression smears were made of Ammon's horn and a portion of the cerebellum, and a thorough search made for Negri bodies. Throughout this entire study the modification of Van Giesen's stain for Negri bodies described by Nagle and Pfau [6] was used.

The present study was undertaken to determine the comparative susceptibility of guinea pigs and mice to rabies virus with the view of establishing the certainty with which a confirmatory diagnosis of rabies could be made by animal inoculation.

From 1921 to 1934 a procedure was followed in this laboratory whereby all animal brains reported negative or doubtful on the basis of microscopic examination were injected intracerebrally into each of two guinea pigs in order to confirm the diagnosis. Since 1934, however, animal inoculations were made only when requested by the epidemiologist (Table II). This table summarizes the findings on 1,988 animal brains submitted to the laboratory for examination from 1921 to 1938. Of the total number of brains received

TABLE II

*Examination of 1,998 Animal Brains for Rabies by Microscopic Examination and by Guinea Pig Inoculation* *

| No. of Animals Examined | Kind of Animals | Microscopic Examination | | | Guinea Pig Inoculations with Negative Microscopic Brains | | Guinea Pig Inoculations with Doubtful Microscopic Brains | | Per cent Reported Positive † | Per cent Found Positive ‡ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Positive | Negative | Doubtful | Negative | Positive | Negative | Positive | | |
| 1,831 | Dogs | 993 | 799 | 39 | 772 | 27 | 29 | 10 | 54.23 | 56.25 |
| 134 | Cats | 3 | 121 | 10 | 120 | 1 | 10 | 0 | 2.23 | 2.98 |
| 10 | Rabbits | 0 | 8 | 2 | 8 | 0 | 2 | 0 | 0 | 0 |
| 8 | Squirrels | 0 | 6 | 2 | 6 | 0 | 2 | 0 | 0 | 0 |
| 4 | Rats | 0 | 4 | 0 | 4 | 0 | 0 | 0 | 0 | 0 |
| 5 | Horses | 1 | 3 | 1 | 2 | 1 | 1 | 0 | 20.00 | 40.00 |
| 1 | Cow | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | Pig | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | Mouse | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | Gopher | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 2 | Human | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 100.0 |
| 1,998 | | 997 | 945 | 56 | 916 | 29 | 44 | 12 | 49.89 | 52.00 |

* Examinations made in the St. Louis Health Division Laboratories from 1921 to 1938.
† Reported positive on the basis of microscopic examination.
‡ Found positive by both microscopic and guinea pig inoculation methods.

997 specimens were reported positive, 945 negative, and 56 doubtful. Of the 945 specimens reported negative on the basis of microscopic examination, 29, or 3.7 per cent, proved positive on guinea pig inoculation, while 12, or 21.4 per cent, of the 56 doubtful specimens proved positive on animal inoculation. The average number of days from the time of injection until the time of death of the first guinea pig of each set was 19.7. Incubation periods varied from 8 to 59 days.

In order to determine the relative susceptibility of guinea pigs and white mice to rabies virus, animals were injected with brain emulsion from 27 dog brains showing Negri bodies on microscopic examination. The brain emulsion from each dog brain was injected intracerebrally into two young (200 gm.) and one old (350–450 gm.) guinea pig, and into each of 4 young (4–6 weeks of age) white mice. The animals were observed for a period of 9 weeks. None of the animals were examined for Negri bodies if death took place within 3 days after the injection. These deaths were considered to be due to trauma. In this group of 81 guinea pigs only 1, 1.23 per cent, died from trauma, while of 104 mice mortality due to mechanical injury was 2.87 per cent.

The results of these comparative experiments are summarized in Table III. Only 9.3 per cent of the 104 mice failed to develop rabies, while 22.2 per cent of the 54 young guinea pigs and 44.4 per cent of the 27 old guinea pigs survived. The average number of days from the time of injection until the time of death of mice showing Negri bodies was 13.3, while the number of days for guinea pigs was 18.4. Furthermore, the first mouse of the series died in an average of 11 days, while the first guinea pig died in an average of 14.5 days. Of the 27 specimens reported positive for Negri bodies, 2 proved negative by the mouse method, while 6 proved negative by the guinea pig inoculation method.

One of these brains (Dog brain No. 2,582) produced rabies in mice in an average of 17 days. One guinea pig receiving an intracerebral injection of this same brain died in 36 days but

Negri bodies were not demonstrated, while the remaining 2 guinea pigs survived. This experiment was repeated at a later date at which time the original dog brain had been glycerinated for 75 days.

Two of 4 mice died in 16 and 20 days, respectively, and Negri bodies were demonstrable, while the 3 guinea pigs survived. Suspecting that guinea pigs were not susceptible to this particular strain of street virus, additional animals were inoculated. Guinea pigs receiving 16 day mouse brain virus died in 13 and 21 days, respectively; while guinea pigs receiving 20 day mouse brain virus died in 15 and 23 days respectively. Negri bodies were demonstrated in each case. This experiment suggests that the mouse is more susceptible than the guinea pig to small amounts of virus of low virulence.

Since St. Louis mice were used in these comparative experiments, due to the limited number of Swiss mice available at the time, an effort was made to determine the relative susceptibility of the St. Louis stock mice and the inbred strain of Swiss mice. The animals referred to in the remainder of this report as St. Louis stock mice consist of three different strains of mice obtained from St. Louis dealers. Ten microscopic

TABLE III

*Comparison of the Guinea Pig and White Mouse Inoculation Methods on 27 Rabid Dog Brains*

| | | Day of Death After Intracerebral Injection | | | | | | | Average Incubation Periods † | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Guinea Pigs | | | White Mice | | | | Guinea Pigs | | | |
| Dog Brain No. | Days in Glycerine * | Young | | Old | | | | | Young | Old | Guinea Pigs | White Mice |
| 2582 | 43 | 36— | S | S | 2‡ | 15+ | 16+ | 20+ | — | — | — | 17 |
| 2585 | 37 | 17+ | 20+ | 33+ | 3— | 14+ | 14+ | 15+ | 15.5 | 33 | 23.3 | 14.3 |
| 2586 | 47 | S | S | S | S | S | S | S | — | — | — | — |
| 2589 | 37 | 6— | S | S | 9+ | 10+ | 10+ | 13+ | — | — | — | 10.5 |
| 2590 | 37 | 12+ | 30+ | 19+ | 9D | 10+ | 15+ | 16+ | 16 | 19 | 20.3 | 13.6 |
| 2599 | 15 | 15+ | 20+ | S | 2‡ | 7— | 9— | 16+ | 17.5 | — | 17.5 | 16 |
| 2606 | 6 | 8+ | 9+ | S | 5+ | 5+ | 9D | 12+ | 8.5 | — | 8.5 | 10.7 |
| 2607 | 6 | 16+ | 16+ | S | 5— | 8+ | 14+ | 16+ | 16 | — | 16 | 12.7 |
| 2608 | 6 | 14+ | S | 25+ | 12+ | 13+ | 14+ | 18D | 14 | 25 | 19.5 | 13 |
| 2609 | 4 | 19+ | 26+ | S | 13+ | 15+ | 15D | 17+ | 22.5 | — | 22.5 | 15 |
| 2610 | 3 | 7+ | 22+ | 13+ | 12+ | 12+ | 13+ | 16+ | 14.5 | 13 | 14 | 13.3 |
| 2611 | 3 | 12+ | 19+ | 11+ | 7— | 10+ | 11+ | 14+ | 15.5 | 11 | 14 | 11.6 |
| 2615 | 5 | 3‡ | S | S | 15+ | 15+ | 17+ | 21+ | — | — | — | 17 |
| 2616 | 5 | 20+ | 20+ | 21+ | 1‡ | 11+ | 14+ | 17+ | 20 | 21 | 20.3 | 14 |
| 2617 | 4 | 9+ | 15+ | 21+ | 9+ | 10+ | 10+ | 14+ | 12 | 21 | 15 | 10.8 |
| 2619 | 1 | 11+ | 23+ | S | 14+ | 16+ | 16+ | S | 17 | — | 17 | 15.3 |
| 2621 | 6 | 12+ | 15+ | 15+ | 9+ | 11+ | 13+ | 14+ | 13.5 | 15 | 14 | 11.8 |
| 2622 | 6 | 13+ | 19+ | 31+ | 8+ | 8+ | 10+ | 12D | 16 | 31 | 21 | 8.7 |
| 2623 | 3 | 27— | S | S | 13+ | 16+ | 16D | 18+ | — | — | — | 15.7 |
| 2624 | 6 | 18+ | 21+ | S | 11+ | 11+ | 14+ | 19D | 19.5 | — | 19.5 | 12 |
| 2625 | 11 | 17— | S | 28+ | 14+ | 17D | 19+ | 23+ | — | 28 | 28 | 18.7 |
| 2626 | 8 | S | S | S | S | S | S | S | — | — | — | — |
| 2627 | 8 | 16+ | 21+ | 34+ | 12+ | 12+ | 17+ | S | 18.5 | 34 | 23.7 | 13.7 |
| 2632 | 1 | 5— | 17+ | S | 14+ | 16+ | 16D | 19+ | — | — | 17 | 16.3 |
| 2635 | 1 | 5— | 17+ | S | 14+ | 16+ | 16D | 19+ | 17 | — | 17 | 16.3 |
| 2638 | 5 | 18+ | 21+ | 26+ | 9+ | 11+ | 13D | 14+ | 19.5 | 26 | 21.7 | 11.3 |
| 2641 | 2 | 14+ | 17+ | S | 8+ | 9D | 11+ | 13+ | 15.5 | — | 15.5 | 10.7 |
| | Average † | 13.9 | 19.4 | 22.2 | 11.2 | 12.0 | 15.8 | 16.4 | 16.2 | 23 | 18.4 | 13.6 |

* Glycerinated brain (cornu ammonis) kept at room temperature for 24 hours, then transferred to ice box at 5° C.

† Average number of days from time of inoculation until death of animals showing Negri bodies.

‡ Animal died from trauma or of unknown complications other than rabies.

D Animal found dead and partially devoured. Examination could not be made.

S Animal survived. No Negri bodies found in brains examined after 9 weeks.

\+ Negri bodies found on microscopic examination.

— No Negri bodies found on microscopic examination.

TABLE IV

*Comparison of Susceptibility of St. Louis Stock Mice and Swiss Mice to 10 Strains of Rabies Street Virus*

| Brain Specimen Number | Mouse Stock | Animals Sacrificed † (days) 6 | 7 | 9 | Day of Death After Injection of Virus | | | Average Incubation Periods ‡ |
|---|---|---|---|---|---|---|---|---|
| 2683 | St. L. | — | — | — | 13+ | 16+ | 19+ | 16 |
| | Swiss | — | — | + | 11+ | 13D | 15+ | 11.6 |
| 2684 | St. L. | — | — | 8D | 10+ | 13+ | 17+ | 13.3 |
| | Swiss | — | — | + | 11+ | 12+ | 15+ | 11.8 |
| 2685 | St. L. | — | — | + | 15+ | 16+ | 21+ | 15.2 |
| | Swiss | 2* | — | — | 10+ | 10+ | 14+ | 11.3 |
| 2687 | St. L. | — | D | — | 10+ | 13+ | 15+ | 12.6 |
| | Swiss | — | — | + | 11+ | 12+ | 19D | 10.7 |
| 2690 | St. L. | — | + | + | 10+ | 10+ | 13+ | 9.8 |
| | Swiss | — | — | + | 11+ | 13+ | 15+ | 12 |
| 2693 | St. L. | — | — | + | 11+ | 11+ | 14+ | 11.2 |
| | Swiss | — | — | — | 10D | 10+ | 13+ | 11.5 |
| 2706 | St. L. | — | — | — | 10+ | 11D | S | 10 |
| | Swiss | — | — | 8D | 11+ | 11+ | 14+ | 12 |
| 2712 | St. L. | — | — | + | 14+ | 15+ | 17+ | 13.7 |
| | Swiss | + | + | + | 11+ | 13+ | 22— | 9.2 |
| 2715 | St. L. | 1* | + | + | 10+ | 13+ | 15+ | 10.8 |
| | Swiss | — | — | + | 11+ | 13+ | 16+ | 12.2 |
| 2717 | St. L. | — | — | 8+ | 10+ | 11+ | 14+ | 10.7 |
| | Swiss | — | + | + | 11+ | 12+ | 15+ | 10.8 |

† One animal sacrificed on each day.
‡ Average number of days from time of inoculation until Negri bodies were demonstrable.
* Animal died from trauma or of unknown complications other than rabies.
D Animal found dead and partially devoured. Examination could not be made.
S Animal survived. No Negri bodies found in brain examined after 6 weeks.
+ Negri bodies found on microscopic examination.
— No Negri bodies found on microscopic examination.

positive dog brains were used in these experiments. The same supernatant fluid from each specimen was injected intracerebrally and intramuscularly into mice of the two groups.

In order to compensate for possible loss in potency of the virus during the injection, mice were taken one from each cage, in rotation, alternating Swiss and St. Louis strains. One mouse from each group was sacrificed on the 6th, 7th and 9th days, respectively. Impression smears of Ammon's horn and the cerebellum were examined for Negri bodies. The results summarized in Table IV show only a slightly greater susceptibility to the rabies virus on the part of the Swiss mice. The St. Louis stock mice died in an average of 12 days, while the Swiss mice died in an average of 11.2 days. Furthermore, the first animal of the St. Louis group died or was found positive in 9.2 days while the first Swiss mouse died or was found positive in 8.9 days.

Based upon the guinea pig inoculation method, several years' experience disclosed an error of 3.07 per cent for brains reported negative on the basis of microscopic examination. Suspecting that this low incidence of error might have been due to the uncertainty of the infectivity of guinea pigs, an experiment was undertaken in which animal brains reported negative on the basis of microscopic examination were injected routinely into each of 4 white mice. Both intracerebral and intramuscular injections were made. In this small series of 68 microscopic negative brains, only 2, or 2.94 per cent, proved positive by the mouse inoculation method. In one of these cases, in which a veterinarian's diagnosis of Dumb Rabies was made, Negri bodies were demonstrable in one of the 4 mice 17 days after the inoculation was made. In the other case a diagnosis of "sus-

pected rabies" was made by a veterinarian. Negri bodies were demonstrable in 11 days by the mouse inoculation method.

SUMMARY

A simple technic for the early diagnosis of rabies by mouse inoculation is described as a convenient means of verifying the routine microscopic (Negri body) method. The results of these experiments show that (1) the white mouse is the animal of choice in the laboratory diagnosis of rabies, Swiss mice being of no practical advantage; (2) that the demonstration of Negri bodies in the test animal is the only dependable criterion for a positive diagnosis since clinical manifestations are frequently too variable and indefinite to be of any value; (3) that it is practical to attempt demonstration of Negri bodies by sacrificing mice on the 8th or 9th day after the inoculation; and (4) that the mouse inoculation test offers a more accurate, rapid, and cheaper means of diagnosis than the guinea pig method.

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# San Francisco's Hotels Are Examined for Cross-Connections

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THE contemplated large influx of visitors to San Francisco during the Exposition Year, 1939, indicated that plumbing of all hotels would be subjected to unusually heavy fluctuating loads. As a preëxposition preparation, a careful program of cross-connection survey was outlined and carried out, the San Francisco Water Department and Department of Public Health working as a single unit.

The principal objective was to guarantee that all hostelries would be free of cross-connections and that all plumbing would be in proper condition to withstand the severe load brought about by abnormally heavy usage. It was felt that San Francisco was not unlike any other large city and that there were serious potential health hazards in the form of unsafe hotel plumbing and that all must be eliminated long before the guests would begin to arrive.

The term "cross-connection" has been used to designate a connection between a potable and an unpotable water supply. More recently, however, the term has been used to include any indirect connection of the potable supply with a polluted system which would allow a return flow on the occurrence of a decreased pressure or partial vacuum in the potable supply line.

After several brief conferences of officials involved, a definite procedure was outlined embracing method of inspection to enforce necessary regulations toward abatement of undesirable conditions.

The city was geographically divided into 55 sections and one inspector of the Division of Water Purification of the Water Department and a plumbing inspector of the Department of Health were assigned to the task of original inspection. Each inspector covered a separate section of the city, 12 to 50 blocks, dependent upon the hotel concentration in each section. A block by block method was followed throughout. Daily reports of each inspection were filed in both departments. All reports showing hazardous or suspicious conditions were filed with the Chief Plumbing Inspector of the Department of Health who in turn assigned the regular inspector of the district to make further investigation, issue orders for correction, and reinspect at inter-

vals to determine degree of compliance.

The survey was inaugurated on June 1, 1938, and was completed by January 1, 1939. During this period, 651 hotels had been inspected. Correction of all hazardous conditions was obtained prior to January 15, 1939, which was a little more than a month prior to opening of the Golden Gate International Exposition, February 17, 1939. Limited time required confinement of our program to building piping, fixtures, and equipment. Inspection procedure in each establishment included general inspection of all piping, a notation being made of size, location, and purpose of same; location and type of sewers, condition of all sewer piping; fire system, and general inspection of any plumbing, water treatment equipment or special house storage. Particular attention was given to special sewage equipment such as pumps, syphon ejectors, and other handling machinery. The number, type, and location of all plumbing fixtures were recorded. Special attention was given to fixtures and connections of food handling equipment.

Buildings equipped with dual water supplies were given minute inspections, special attention being given to cross over line safety facilities.

As a result of minor repair work and extensions by resident engineers or maintenance men, inspectors found in some instances a maze of piping that made inspection difficult and time consuming. Unfortunately, in such instances because of turn-over of personnel, blue prints of the house piping were rarely available, and if so, the prints were usually the original building construction plans which did not in any way resemble the existing conglomeration of pipes.

Of the 651 hotels inspected, 82, or 12.6 per cent, were found to have one or more serious plumbing hazards. Most of the defects existed in the larger hotels which in terms of total rooms and persons exposed would, of course, indicate a higher percentage of hazards.

From the individual reports, a compilation of data was made grouping hazards into 7 classifications, which were further classified under 27 separate items. The number of hazards found in each of the 7 groups were: direct sewer and water department water connections, 22; equipment with submerged inlets, 20; fixtures with submerged inlets, 1,359; prime lines ejectors and pumps, 59; other sources of water, 17; plumbing defects, 12; miscellaneous, 12, or a total of 1,501 hazards.

While enforcing corrective measures, no attempt was made to force owners to replace fixtures or equipment other than to correct connections to them. Sound advice and encouragement were given, however, looking to future remodeling or extensions when fixtures and equipment could be replaced. All owners were encouraged to consider gradual replacement of undesirable fixtures and equipment.

In addition and as an adjunct to the cross-connection survey, the method of routine bacteriological check of the general water supply has been revised. In place of sampling 3 days each week from 8 control points, there has been instituted sampling 3 days per week from 8 control points and 1 day per week from 16 control stations, the additional 8 being storage and pressure tank outlets within the city limits. In addition samples are examined once each week from hotels with dual water supplies.

As a result of this survey and correction of hazardous conditions found, it can be stated that the plumbing fixtures in all of our hotels are reasonably safe.

SUMMARY

The San Francisco Health and Water

Departments completed a cross-connection survey of all hotels prior to the opening of the Golden Gate International Exposition.

A definite procedure of covering the entire city was outlined and an inspector from each department assigned to the survey. Any hazards disclosed were brought to the attention of the regular district plumbing inspector, who followed through and obtained correction.

Six hundred fifty-one hotels were inspected in a period of 6 months; 82, or 12.6 per cent, were found to have a grand total of 1,501 hazards. All were corrected more than 1 month prior to opening of the Golden Gate International Exposition. Bacteriological examination of drinking water was increased to 4 times weekly, and the routine was broadened to include a wider range of storage and flow.

## CONCLUSIONS

From this survey it is evident that entirely too much uncontrolled plumbing extensions, repairs, and remodeling are done routinely and unwisely in certain type buildings in large cities. As a result many plumbing hazards and potential hazards are established. Accurate blue prints of such work are not maintained, resulting in confusion because of changing personnel. It is evident that a community would reap large dividends through a small expenditure to finance a survey as herein described at least every 5 years. All building owners would benefit considerably by requiring maintenance men to file corrective blue prints on the premises every time changes were made in plumbing facilities regardless of how minor the nature of these changes may seem.

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## NOMENCLATURE FOR THE COLON GROUP

THE nomenclature of the group of organisms with which we are chiefly concerned in our examinations of water and sewage, those which have for a long time been called in textbooks the colon-typhoid group, is still far from having been settled, and the usage which one finds both in textbooks and in journals is very confusing. Several years ago an attempt was made to formulate a definite nomenclature which would be followed in this *Journal*, but no agreement could be found among those who were believed to be best able to form an opinion.

Some two years ago the Secretary of the American Water Works Association and Editor of the *Journal* of that Association published a clear statement of the facts and announced the terms which would be used in that *Journal*. This nomenclature has worked acceptably.

In October, 1936,[1] a paper on this general subject was presented to our Association at the New Orleans meeting, in which the matter was discussed clearly and logically. This paper was the result of correspondence which had been carried on for several years by the two authors and we believe represents the best usage in vogue today. The authors suggested that these organisms be known as the "coliform group," and asked that sanitarians in the dairy and shellfish fields should be careful to use a terminology which would neither broaden nor restrict the definition of the organisms included under this term. This group included: "(1) aerobic or facultative anaerobic, (2) Gram-negative, (3) non-spore-forming organisms which (4) ferment lactose with (5) gas formation." This is the coli-aerogenes group of *Standard Methods*, 8th edition. The new *Standard Methods for the Examination of Dairy Products* uses the term "coliform" in the sense here outlined, placing in parentheses the correct Latin terminology (*Escherichia-Aerobacter*).

In dealing with the group of organisms generally used as an index for pollution, it is recommended that authors use the expression "coliform group." While *Escherichia-Aerobacter* is the accepted Latin terminology for this group, the term "coli-aerogenes" is officially used in the 8th edition of *Standard Methods for Water Analysis*, and will also be accepted as long as it remains in that volume,

but the former expression is to be preferred and has found its way during the past two years into the literature dealing with water analysis.

We ask our contributors to be careful in the use of these terms and to follow nomenclature adopted by the American Water Works Association and now by ourselves, for the sake of uniformity and clarity.

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## INSPECTION AND DISINSECTIZATION OF AIRPLANES

WE have several times commented on what the tremendous increase in the use of the airplane means to us from the public health standpoint,[1] notably very recently [2] we have mentioned the fact that the *Anopheles gambiae* has reached South America, presumably by means of an airplane from West Africa or on board one of the fast French destroyers which worked in connection with the French air lines between Dakar, West Africa, and Natal, South America, at that time.

In the daily papers we have just been reading with tremendous interest the report of the test flight of the Yankee Clipper from Baltimore to the Azores and Europe and back again and have noted that the regular commercial flights of this line of airplanes is scheduled to begin within a few months so that Europe will soon be connected with us by regular scheduled flights. The port of selection for this country is Baltimore, with Charleston, S. C., as the alternate landing place on account of its freedom from fogs. This news adds particular interest to reports [3] from our Public Health Service, some of whose activities in this respect have already been mentioned in our columns.

The *Baltimore Health News* [4] gives us up-to-date news for that city, where the Surgeon in charge of the U. S. Public Health Service Quarantine Station, is a member of the Advisory Committee on Sanitation of the Baltimore City Health Department. He and his predecessors have served in this way since February 14, 1933.

Quarantine officers make routine examinations of aircraft as well as of other ships coming into Baltimore, and passengers from foreign countries are inspected on arrival. With the inauguration of the transatlantic service doubtless similar arrangements will be made for Charleston, S. C.

Miami has a strategical position as an airport of entry for planes from South America and the West Indies. The inspection there of aircraft is made primarily for the detection of living mosquitoes, particularly *Aedes aegypti*.

During 1938, 398 airplanes from Central America, South America, and Mexico were inspected at the Pan American Airport, Dinner Key, Miami, Fla. Of these, 187 harbored many dead and some live insects. Of 651 insects recovered, 166 were alive. There were 45 mosquitoes on the plane, 40 dead and 5 alive. One was so crushed as not to be identifiable. Of the 5 living mosquitoes, none belonged to disease carrying species. Among the dead there was one *Anopheles albimanus*, which is one of the 26 listed by Covell as being the chief malaria-carrying Anopheles of the world. The *Anopheles albimanus* is found in Mexico, in Central America, and in South America, so that the indications are that it came from one of those countries, though it did not survive the trip.

House flies, midges, gnats, and other small flies, beetles, wasps, ants, moths, cockroaches, chinch bugs, as well as two spiders were found during the year.

Our Public Health Service has been on the alert since the airplane became a vehicle of international transportation. One-half hour before landing at Miami and at all other ports of call en route, planes from the south are sprayed with an atomizer containing a standardized pyrethrum extract, 2 grams of pyrethrin per 100 cc., plus 4 parts of a highly refined mineral oil. The planes' ventilators are kept closed for approximately 10 minutes after spraying on overnight stops. After disembarkment of the passengers and crew, thorough spaying is done and the plane closed for the night.

In addition to these precautions, trapping mosquitoes around Miami has been carried on for two years, during which 214,285 specimens of mosquitoes were taken. Each was identified and the survey showed that no new species of mosquito were detected and no species not already known in that area were found. We therefore have every right to feel that our health is being adequately safeguarded in this as well as in many other respects.

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## LIABILITY FOR INJURIES DUE TO IMMUNIZATION

PROTECTION of individuals against disease by artificial immunization with vaccines, antitoxins, and sera is one of the most important of modern public health procedures. Millions of persons have been thus safeguarded against the ravages of smallpox, diphtheria, typhoid fever, tetanus, rabies, and various other dangerous communicable diseases.

Such immunizations are almost invariably harmless. They may cause some slight discomfort and inconvenience, but any temporary disturbance is as nothing compared to a case of the disease itself.

On rare occasions, however, injuries have resulted from immunizations. In most instances these have been due to negligence and carelessness on the part of the manufacturer of the biological product, the physician using it, or the patient himself. When ordinary care is employed, there is no possible danger from immunization, except in the relatively few cases of those who are unduly sensitive.

When such an injury occurs, the person actually responsible for it will be liable for damages to the injured person. As a rule, this action is based on negligence, which must be proved in a court of law by a preponderance of competent evidence.

An interesting case of this nature was tried recently in the Irish Free State.[1] A county medical officer of health arranged that the boys and girls of several schools should be immunized against diphtheria. He obtained toxoid antitoxin floccules from a reputable manufacturer in England and turned them over to a local medical health officer, who injected the children. Some weeks later, 24 or 25 of those who had been inoculated became ill, 4 in particular of one family

developed tuberculous abscesses, of whom one died from generalized tuberculosis.

The father, a teacher at the College, named Michael O. Chionnfhaolaidh (Kineally in English) sued the physician and the manufacturer in the High Court in Dublin for damages.

There was a great deal of testimony by actual witnesses and by medical experts to show that the proper technic was employed by the physician in giving the injections. Since there was, furthermore, no contract of sale between him and the plaintiffs, and no expressed or implied warranty by him of the quality of the product used, the case against the physician was dismissed by the presiding justice of the court, without submission to the jury.

The case against the manufacturer went, however, to the jury. Here the testimony showed that the manufacturer apparently could not have been negligent in preparing the toxoid and that the product could not have been contaminated with tubercle bacilli. There was also testimony by experts tending to fix the blame on the physician who performed the inoculations. The jury gave a verdict in favor of the manufacturer, which would seem to be justified by the evidence as it is reported. The father who had lost one child and had had three others infected was, therefore, unable to recover from anyone for this legal wrong.

In this country, it has been held by the courts that a manufacturer of a biological product is bound to use due care in its preparation and distribution, so as to protect the health of those using it. For failure to observe these duties, the manufacturer will be liable in cases of resulting injury, but he will not be liable for the improper, careless, or negligent administration of the product by physicians and others.[2] A municipal corporation will not be liable for injuries due to immunizations performed as part of its governmental functions. Since the individual who causes the injury by his negligence will be personally liable, due care must be taken by health officers and their subordinates and employees, and by city physicians and private practitioners in performing these usually beneficial minor operations.

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# BOOKS AND REPORTS

**Background to Modern Science**—*Edited by Joseph Needham and Walter Pagel. New York: Macmillan,* 1938. 243 pp. Price, $2.00.

This most interesting series of lectures had its inception in the belief that the lack of an organization for the study of the history of science at Cambridge, England, constituted a serious gap. In 1936 efforts began to remedy the situation. A committee was formed for arranging courses of lectures on the history of science. The committee has no doubt that the lectures given so far have been meeting a real need, and points to the fact that a great concourse of students, many standing or sitting on the floor, have gathered to hear these expositions of the progress in the sciences during the past 40 years.

It need hardly be said that no one reviewer could speak from intimate knowledge on all the topics discussed in this volume. Consequently the book has been submitted to a number of specialists and this notice is the result.

The names of the various lecturers are sufficient in themselves to assure us of the authenticity of the material presented and also of the excellent style in which the presentation is made. For almost every subject the inherent interest is enriched by the close connection which the author has had with the development of the field of which he writes. Two of the articles, those by Lord Rutherford and Dr. G. H. F. Nuttall, have especial interest as being the last public lectures which they gave. Lord Rutherford died before he could correct his proof and this service was well performed by J. A. Ratcliffe.

There is a uniformity of treatment unusual in a book written by so many authors, which reflects credit on the editors. Duplication has been avoided to a remarkable extent and each author has kept in mind the fact that he was expounding abstruse subjects to an audience many of whom were either lay or not yet far advanced in the sciences discussed. The result is that the reader is not confused by a great mass of detail. The more important facts are given under each subject in language which is unusually simple and holds one's interest. There is not a lecture which cannot be read with pleasure and profit by the average layman and the whole series can be recommended unreservedly to the public, lay and professional alike.

MAZÝCK P. RAVENEL

**Sanitary Law—In Question and Answer**—*By Charles Porter, M.D., Barrister-at-law, and James Fenton, M.D.* (4th ed.). *London: H. K. Lewis & Co. Ltd.,* 1939. 352 pp. Price, $2.75.

Unlike public health legislation in the United States, which emanates from 49 different legislative bodies of the national government and the states, and shows it, all statutory law concerning public health in England is enacted by a single authority, the British Parliament. In England as here, however, there may also be subordinate legislation, such as by-laws and regulations promulgated by administrative departments. As a consequence, public health legislation in England is both profuse and complex, although it has been codified to a certain extent by the consolidation of the Public Health Acts in 1936.

This book, the first edition of which was issued in 1910, is an excellent guide to public health legislation in England. Its utility is enhanced by a good index. Americans interested in comparing British health legislation with our own scattered, diverse, and lavish health laws will find it of value.

JAMES A. TOBEY

**A Textbook of Orthopaedic Nursing**—*By Evelyn C. Pearce, with a foreword by the late Sir Robert Jones, Bart, and introductory chapter by Dame Agnes Hunt.* (2nd ed.). *London (24 Russell Square, W.C. 1): Faber and Faber, Ltd.*, 1939. 230 pp. Price, $2.50.

The author states that "the object of this book is to help nurses in training in the general hospitals of the country to a better understanding of the treatment of orthopaedic cases and consequently to a deeper interest in this branch of surgical nursing." It is really more than this, as it sets forth in clear and concise form the important facts with which all those interested in orthopedics are concerned. The book is exceedingly well written and illustrated. The preventive viewpoint, as well as the corrective, is stressed throughout. It is written in the language and style which we associate with well prepared English texts. The chapter by Dame Agnes Hunt, R.R.C., is well worth careful reading. Especial attention is given to crippling due to tuberculosis, rickets and poliomyelitis.

This little treatise can be recommended not only to nurses in training, but also to medical social workers, physical educators, and physiotherapists.

RICHARD A. BOLT

**Annual Report for 1937, International Health Division, Rockefeller Foundation.** *New York: Rockefeller Foundation,* 1938. 243 pp.

Public health and scientific research work of the Rockefeller Foundation, as reviewed in this report, indicate in a stimulating manner some of the major problems yet unsolved as well as gratifying progress in many fields. Highly valuable digests are given of papers on projects carried out under International Health Division auspices published elsewhere, together with references to the original literature.

Rapid advancement of knowledge regarding the virus diseases opens up promising new fields of investigation and control. At least four of these diseases are being studied, namely, influenza, vaccinia, rabies, and yellow fever. A virus of influenza has been isolated by transfer from man to ferret and transmitted from ferrets to mice. It is being employed diagnostically in standardized tests of human sera in mice for the specific protective antibodies. The virus grown in tissue culture has been used in experimental vaccination "with encouraging results."

The epidemiology of jungle fever is being attacked on several fronts, and improved methods of vaccination are being used to protect persons under exceptional exposure. Steps are being taken to prevent the carrying of infected persons during the incubation period to infectable countries by airplane or otherwise, in addition to precautions against the carrying of infected mosquitoes by airplanes. "A year's experience in the production and application of a cultured yellow fever vaccine virus, during which more than 59,000 persons were inoculated, mostly in Brazil, shows that there is now available a practicable safe method of large-scale immunization."

Studies of malaria, tuberculosis, yaws and syphilis are also reviewed, aid given to state and local health services is briefly described, and assistance given in various countries to the advancement of professional education is outlined.

This is an impressive record of service which should give much encouragement as well as useful information to public health workers. IRA V. HISCOCK

**A Biological Approach to the Problem of Abnormal Behavior**—*By Milton Harrington, M.D. Lancaster, Pa.: Science Press Printing Co.*, 1938. 459 pp. Price, $4.00.

In this lengthy work Dr. Harrington has apparently erected the major part of his structure of theories for a new approach to the problem of abnormal behavior, for which he cleared the ground in his previous book, *Wish Hunting in the Unconscious,* published in 1934. In the early work he suggested a mechanistic psychology as opposed to the motivistic psychology of psychoanalysis, and it may be presumed that the intervening years have seen no change in his opinions concerning the defects and shortcomings of the Freudian explanations.

The book has an introduction, three parts, a résumé and an index. In the introduction, a short and clear opposition to the schools of Drs. Freud, Jung and Adolf Meyer, the author gives many reasons for his rejection of the animistic approach and presents his theory of a psychology built upon a physiological foundation.

Part one, offers the explanation of his basic concepts and methods and the problems of free will and animism, but still attacks Freudism very forcefully; for example, in his diatribe on the substantiation of the phenomena of consciousness, Dr. Harrington says: ". . . there were added to it the concept of the unconscious . . . a concept of which has been carried to its highest, or perhaps one should say its deepest, level of absurdity in the speculations of Dr. Freud." Since, according to his theory, every symptom hitherto explained on psychological grounds would be explainable physiologically, the old psychology has little value except to help in establishing a more direct theory, after which it would be completely nonessential.

In Part two, the author gives his physiological explanation for psychical phenomena. By starting with the conditioned reflex and deducing therefrom that conditioning is a matter of opening new paths through the nervous system for the transmission of nerve impulses, he proceeds to place sensations, emotions, memory and thought, craving and satisfaction, on a physiological or rather neurological basis (which seems more a change of name than a change in conception), dismissing the psychoanalytic theory, at least as it concerns forgotten memories, as untenable, without, however, being in complete agreement with the Watsonian Behaviorists. Similarly, mental adjustment is defined as "a matter of getting relief from nervous tension." Pain, pleasure, mirth, and anticipation are discussed as tension mechanisms, a theory upon which Dr. Harrington erects the third part of his book—the theory of mental disorder of psychopathology.

The author continues in his mechanistic approach to abnormal behavior by defining psychopathology as "the mechanism of behavior functioning in a quite unsatisfactory way," or the sense organs failing to "report" correctly in regard to the situation, or the failure of the "effectors" to respond to the demands made upon them; in other words, regarding psychopathology as neuropathology. Here he demonstrates his disagreement with the theories of the Kraepelinian psychiatrists by stating that there are four factors in the production of abnormal behavior—defective heredity, somatic disease, wrong education, and the stimuli afforded by difficult or trying situations, and avers that the two latter causes have been overlooked by the

followers of Kraepelin. He sets out to show that these factors can be caused by faulty transmission of nerve impulses or the paths "cut in his nervous system by previous experiences."

In spite of the author's determination to differentiate between the psychoanalytic or motivistic conception of the subconscious and his neurological or mechanistic explanation, it is difficult to see that there is any basic difference except in nomenclature. Here is an earnest effort to simplify to the average mind the mental processes by reducing them to a more concrete formula in physiological terms. Perhaps the book's virtue lies in the fact that an equation can only be solved by simplification, the removal of all unnecessary indices and brackets and ciphers; but it appears that where the workings of the mind are concerned such an equation must of necessity involve very complex and varied factors in the first place, which can only be brought to a simple equation by long, arduous and carefully studied work, with perhaps generations of experience, if the final answer is to be found. RALPH S. BANAY

**Communicable Diseases for Nurses**—*By A. G. Bower, M.D., and E. B. Pilant, R.N.* (4th ed.). *Philadelphia: Saunders,* 1939. 547 pp. Price $3.00.

This latest edition of a book which has made a place for itself in the three editions which have gone before is welcome. It is written for nurses, and stresses the essential steps of nursing care and management. The chapters on Tuberculosis, Syphilis, and Gonorrhea have been rewritten by specialists in these branches, and an entirely new chapter on Public Health Control of Communicable Diseases has been added. The arrangement conforms to the curriculum guide outline.

The changes and additions to the book are well done and this fourth edition maintains the high standard set by the previous ones. It can be recommended without hesitation for the teaching of nurses as well as a practical guide for graduates. The printing and make-up of the book are excellent. ELEANOR KEELY

**Fundamentals of Dentistry in Medicine and Public Health**—*By John Oppie McCall, D.D.S. New York: Macmillan,* 1938. 161 pp. Price, $2.75.

This book owes its existence to the fact that the author was invited by Dr. Smillie, Professor of Public Health and Preventive Medicine of Cornell University Medical College, to give some instruction regarding the teeth to medical students. For this purpose he prepared a "Primer" of which the present book is the successor.

The author lays his foundation properly on embryology and histology, then goes on to consider the various diseases to which the teeth are subject and the effect which these diseases have or may have on the general health. Some of the subjects, such as occlusion, pyorrhea, the so-called dead teeth, and caries, are constantly spoken of by the laity and have an interest for everyone.

Of late years diet and its relation to the development of teeth and their health has occupied the stage in an increasing degree. Under this general heading the relation between saliva and dental health is discussed to an extent slightly out of proportion to facts which have so far been established. While the subject is of immense interest the findings are hardly conclusive enough to claim a place in a book confined to fundamentals of dentistry.

The Glossary is particularly good. The illustrations are abundant and the printing is excellent. While intended primarily for medical students and public health workers, it can be recommended also to all dentists as a re-

fresher and to the medical profession, which so far has not enough acquaintance with the underlying principles to enable it to view judicially the fads for which both they and the dentists have been responsible. We refer particularly to the tooth pulling orgy for the cure of everything from hives to Bright's disease. The author is to be congratulated on his clear statements and his ability to condense the vast amount of useful information which he presents. A less able writer might easily have used twice the space without gaining anything in interest or instruction.

We wish for this useful little book the wide circulation that it deserves.

C. F. ELZEA

**Health and Unemployment: Some Studies of Their Relationships**—*By Leonard C. Marsh, in collaboration with A. Grant Fleming and C. F. Blackler. New York: Oxford University Press,* 1938. 243 pp. Price, $3.00.

This is the seventh publication in the McGill University Social Research Series. It is divided into 5 parts: (1) The elements of the problem—health and economic conditions, indices of public health, unemployment and nutrition; (2) adult workers—nutrition, physical handicaps and mental health; (3) juveniles and adolescents; (4) the family, including minimum standard budgets and relief; and (5) provision of medical care.

In discussing needs based on careful studies, the authors comment as follows:

> In form, public health protective services are community-wide. They are intended to safeguard all citizens regardless of their economic standing. But even the benefits of safe milk and foods are limited, however, in a positive sense, to those who are able to purchase the variety of foods and the quantity of milk necessary for good health. Even more is this true of housing; and a correlation between low wages or low skill, and poor working conditions is well established. While the blanket of public health measures may be equally spread, therefore, it cannot ensure equal coverage while these other limitations on health are unmet. Conditions of nutrition, which have come to the fore in the majority of the present studies, are an outstanding indication of this.

Furthermore, it is revealed that tuberculosis, also high in the ranks of the killing and crippling diseases, is more clearly a disease of the poor. It flourishes under those conditions which are commonly associated with poverty, poor nutrition, unhygienic living conditions, insufficient rest, and overfatigue. A considerable amount of untreated tuberculosis was found among an unemployed adult group.

Among the unemployed groups examined only 55 per cent of the adults and 47 per cent of the youths could be rated as showing a good nutritive state. Of special interest is the statement that neither social agency cases nor those found on the relief rolls in the earlier years of the depression are representative of the "new unemployed." It is observed that the hardships of a reduced standard of living, and the incidence of ill-health, may well be greater among these latter groups than among the "old" unemployed. The authors advise that a survey to determine this will need not only to distinguish persons who have been on relief for short and for long periods, but also to cover unemployed persons not on relief.

Consideration of the problem of medical care includes a discussion of health insurance and this final paragraph.

> The experience of health insurance in Great Britain is now well known: strongly opposed by doctors at the time of its passage over 25 years ago, the system in its essentials today has the complete support of the medical profession. The British Medical Association has placed on official record its approval of extensions of coverage and types of medical service in many directions, which will ultimately establish it as a complete system of medical care for the nation. In Canada many

spheres of medical care require attention before this stage is reached. But several important steps have been taken. Government-assisted medical care for the unemployed has been inaugurated and must be regarded as here to stay. The most immediate need is to improve these services and fill the gaps. Every extension involves responsibilities, but these will have to be undertaken if individual medical care for the mass of the population is to be brought up to the standards of adequacy and efficiency now accepted as necessary in public health facilities in the Dominion.

IRA V. HISCOCK

**Historical Directory of State Health Departments in the United States of America**—*By Robert G. Paterson, Ph.D. Columbus, Ohio: Ohio Public Health Association,* April, 1939. 68 pp. Price, $1.00.

This historical directory is designed to trace the changes which have occurred in each state jurisdiction since the establishment of the first permanent state health organization in Massachusetts in 1869 and to serve as a source of information relating to the terms of each state health officer, the reports which have been issued, and other publications by the state department.

The volume has both historical and personal interest for those whose acquaintance extends over a number of years. It would appear from these data that the present state health officer of Wisconsin has been in office longer than any other, and that seniority is thereafter in the following order: South Carolina, Montana, Kentucky, Georgia, California, Minnesota and Connecticut, though in two cases the service of these state health officers has not been continuous.

A specially useful feature is the bibliography of publications descriptive of state health departments. While not entirely complete, this list is probably the only compilation of its kind. This publication represents a public service of the Ohio Public Health Association which will be of wide use to the public health profession and should be in every library.

REGINALD M. ATWATER

**Baby Care**—*By May E. Law, M.B., Ch.B. Philadelphia: Lippincott,* 1938. Series of 13 Booklets. Price, $2.00.

*Baby Care* is a unique and attractive series of thirteen booklets covering the important features of the care of infants from the prenatal period, month by month, through the first year of life. The booklets are encased conveniently in a durable cardboard container. Each section is written in simple, direct English and appropriately illustrated throughout. Mothers will appreciate the many helpful suggestions presented in understandable terms.

The author of this series is a woman physician, graduated from the University of Glasgow. She has had practical experience with children at the Royal Hospital for Sick Children in Glasgow, at Queen's Hospital for Children in London, and in the Hospital for Women and Children at Shadwell. Her interest in preventive pediatrics is attested by the fact that she was medical officer to Infant Welfare Centers in London and served as school medical officer for the County of Essex.

The viewpoint of this series is thoroughly modern and measures up to the standard of present-day pediatrics.

RICHARD A. BOLT

**A Pocket Medical Dictionary**—*By Lois Oakes, S.R.N., Assisted by Thomas B. Davies, M.D.* (3rd ed.). *Philadelphia: Peter Reilly Co.,* 1938. 397 pp. Price, $1.00.

This handy small medical dictionary can be conveniently carried in one's pocket, and read at odd times as one travels or waits for a conveyance. A number of people occasionally read an English dictionary, not to solve cross-

word puzzles, but to improve their vocabularies. This dictionary can serve an equally good purpose in giving information on medical words and terms. It was prepared primarily for medical students—particularly British—as some of the data refer to titles and nomenclature commonly used in Britain. The book is not the less valuable on this account, or because its author is a nurse, for, as a member of examination boards, she has had wide experience in defining names and terms. Moreover, she was assisted by a physician, who is a prominent pathologist.

The supplementary information on abbreviations, dosage, diets, poisons, antidotes, and gas warfare precautions are useful, and the data on this last item indicate the recentness of the revision and its applicability to England.

In a small book all the less common diseases (such as Wernicke's) could not be included, and a few slips might be expected in printing, such as in column 2, page 2, line 13.

JAMES WALLACE

**Laws re. Sanitization: Regulatory Measures Concerning the Sanitization of Drinking Utensils in Public Places.** *New York: Public Health Committee of the Cup and Container Institute,* 1938. 39 pp.

The adoption of a new word, however much it may be needed, always meets opposition. There are excellent reasons why we should never say sterilization when we mean disinfection or, in the present discussion, the cleansing of drinking glasses and eating utensils. The word "disinfection" connotes so many other processes, its application to the aim of good dish washing methods stands against its use here. It seems certain therefore that the word sanitization will be adopted—in fact it has been adopted in this valuable compilation of laws and regulations which concern the cleansing of public eating and drinking utensils.

There is definite need for a model ordinance to aid health officials and legislators in setting up local sanitary regulations. This compilation of "laws" makes the lack of such a guide all too evident. Examination of only a few of its pages will reveal the wide variety and range of regulatory demands which are more or less in effect in our several states. Regulatory measures which are obviously not enforceable are worse than no rules at all—except that they emphasize the need for intelligent guidance.

The following quotation from the preface is an accurate summary of this timely publication: "Glance at these laws. Some ordinances legally permit the use of chlorine as a sanitization agent; others do not. Sanitization by means of hot water is favored here and shunned there, and there is general disagreement as to temperature requirements and holding time. Although paper service is everywhere acceptable and in practice approved, not every ordinance contains a provision for its use. The required chemical content of rinse waters varies widely as does the time of exposure. Towel-drying is allowed in some places while air-drying is ruled elsewhere. Penalties fixed for violation of sanitization ordinances range in different cities from no stated amount to $100 or 90 days imprisonment or both. And so on. The diversity of procedures has itself become a public health plague, and the efforts to eliminate contaminated utensils are to that extent frustrated."

A. P. HITCHENS

**Medical Vocabulary and Phrases: English, German, French, Italian, Spanish**—*By Joseph S. F. Marie. Philadelphia: Blakiston,* 1939. 358 pp. Price, $3.00.

This is a very useful medical vo-

cabulary giving English, German, French, Italian, and Spanish equivalents. From its arrangement it will be more useful in writing and preparing papers than for translation since the rendition is from English into the other languages. However, many words, especially in English, French, Italian, and Spanish are very much alike and often spelled the same, or very nearly the same. Even for German there are many closely alike, especially scientific terms.

An appendix contains short and clear comments on the pronunciation of the vowels and consonants, syllabification, genders, and plurals of the four foreign languages. Finally 8 pages are given to medical phrases which one constantly uses in the hospital and field. It is said in the preface that the book is intended particularly for physicians and surgeons, public health and military medical officers, and nurses.

Reviewing a dictionary is difficult. One can only look for a certain number of test words. In this instance this has been done by several persons and no errors have been detected. The printing and make-up of the book are excellent. It is a most useful book for any editor or writer.

MAZŸCK P. RAVENEL

**The Mental Hygiene Movement from the Philanthropic Standpoint** —*New York: Department of Philanthropic Information, Central Hanover Bank and Trust Company,* 1939. 73 pp. Reprints available from National Committee for Mental Hygiene, 50 West 50th Street, New York, N. Y., at $.25.

This is one of a series of surveys being issued by the Department of Philanthropic Information of the Central Hanover Bank and Trust Company.

The argument is founded on "the fact that mental disease, like physical disease, is due to natural causes, and, therefore, more or less preventable and more or less amenable to treatment."

The mentally incompetent are divided into the psychotics (the insane), of whom as of January 1, 1937, there were 697,083 in the country, and the mental defectives, of whom, at the end of 1936, there were 99,374 in institutions, and 15,200 on parole, though "'the vast majority of them are not confined in institutions but live at large in the community.'" The economic loss from mental disability, including loss of earnings and the cost of caring for these two classes, has been estimated at more than $1,100,000,000 per year. The outlook is that more than one million boys and girls now in public schools will spend a part of their lives in institutions for mental disease.

An interesting historical summary is given. It was not until the close of the 18th century that Philippe Pinel in France, William Tuke in England, and Benjamin Rush in America recognized that mental disorder is an illness affecting the mind and not due to demoniacal possession or supernatural causes. The curability of mental disease evolved slowly. Dorothy Dix, in 1841, undertook an inquiry into the treatment of the insane in Massachusetts. The Civil War not only stopped her work but led to a retrogression in the study of the question. In 1844 what is now known as the American Psychiatric Association was formed. It was not until 1875 that the American Neurological Association came into being. There was a bitter fight between the neurologists and psychiatrists, with mutual distrust. The turn of the 19th century gave Kraepelin, whose work brought order out of chaos and shifted the emphasis of psychiatric research from the deadhouse to the living patient. Next came psychobiology, under the leadership of

Adolf Meyer, who taught that "mental disease was to be regarded as a 'maladjustment of the *whole personality,* rather than as a brain disease in the purely physiological sense.'" The spark which touched off the present movement came in 1908, when Clifford W. Beers wrote his autobiography, *A Mind That Found Itself.*

Perhaps nothing will appeal to the public more than the humane care and intelligent treatment which is now given at many institutions for the mentally diseased, and the hope which they hold out for cure, not only through surroundings and care, but through medical treatment. High among these comes the treatment for syphilis, which is responsible for approximately 10 per cent of all new cases of mental disorder. Even the most baffling of mental disorders, dementia praecox, which accounts for about 50 per cent of some one-half million patients now in our mental hospitals, seems to be yielding in a fair number of cases to the "shock" therapies recently introduced.

Much attention is now being paid to mental hygiene, which means prevention—beginning with child guidance, schoolroom guidance, and mental hygiene in our colleges and universities. Of this new development it may be said "'a great multitude of persons are living happier and more efficient lives because of their knowledge of mental hygiene.'"

There is a good statement of the needs for the continuance and enlargement of this work. Mental hygiene societies have been formed in 26 states which supplement and reënforce the activities of the National Committee. The most urgent need in mental hygiene is for qualified teachers and practitioners of psychiatry. Fortunately, the requirements are extraordinarily high, the standards being set by the American Board of Psychiatry and Neurology.

Conditions in our mental institutions are not satisfactory. Many state hospitals, even those of enormous size, such as that at Brentwood, N. Y., with 8,000 beds, are overcrowded. In many parts of the country the mentally ill can still be found in almshouses and penal institutions, where medical care is inadequate. The cost is more than 200 million dollars a year, yet the combined funds of 48 states for research is less than one million dollars a year.

This booklet has been carefully prepared for the laity, and the reviewer is treating it from this standpoint, being a layman as far as mental disease goes. It is the clearest and most convincing statement of the situation the writer knows of. It can be commended to all laymen and to medical men as well, most of whom are, as it were, frightened away from mental diseases by the many new terms coined by psychiatrists and psychologists, which are not understood even by many of those who specialize in these branches.

The booklet is interestingly written, easily read, and free from the technical language which has led to confusion and obscured the facts by a mass of new-made verbiage. MAZŸCK P. RAVENEL

**Your Baby and Child: A Book for Mothers**—*By M. C. Overton, M.D., F.A.A.P. Lubbock, Texas: Your Baby & Child Publishing Co.,* 1936. 224 pp. Price, $2.00.

This is a simply written book in words which the mother can easily understand. It is made up of a number of short chapters covering practically all of the questions which an intelligent mother might ask. The arrangement of the material is by no means systematic, but a complete table of contents and index in large type make it easy to find the topic under discussion. The advice given to mothers follows generally modern pediatric practice.

RICHARD A. BOLT

# BOOKS RECEIVED

PUBLIC HEALTH LAW. By James A. Tobey. 2d ed. New York: Commonwealth Fund, 1939. 414 pp. Price, $3.50.

CORRECTIVE PHYSICAL EDUCATION. By Josephine Langworthy Rathbone. 2d ed. Philadelphia: Saunders, 1939. 305 pp. Price, $2.50.

THE ENDOCRINE GLANDS. By Max A. Goldzieher. New York: Appleton-Century, 1939. 916 pp. Price, $10.00.

THE CLINICAL AND EXPERIMENTAL USE OF SULFANILAMIDE, SULFAPYRIDINE AND ALLIED COMPOUNDS. By Perrin H. Long and Eleanor A. Bliss. New York: Macmillan, 1939. 319 pp. Price, $3.50.

YOUR CITY. By E. L. Thorndike. New York: Harcourt, Brace, 1939. 204 pp. Price, $2.00.

MALARIA EDUCATION. By Elma Rood. Madison College, Tenn.: Rural Press, 1939. 198 pp. Price, $2.00.

HEALTH FACTS FOR COLLEGE STUDENTS. By Maude Lee Etheredge. 3d ed. Philadelphia: Saunders, 1939. 410 pp. Price, $2.00.

NUTRITION AND PHYSICAL DEGENERATION. By Weston A. Price. New York: Hoeber, 1939. 431 pp. Price, $5.00.

TECHNICAL COMMISSION ON NUTRITION. Guiding Principles for Studies on the Nutrition of Populations. By E. J. Bigwood. League of Nations: Geneva, 1939. 281 pp. Price, $1.50.

NURSING MENTAL DISEASES. By Harriet Bailey. 4th ed. New York: Macmillan, 1939. 264 pp. Price, $2.50.

AN INDUSTRIAL DEPARTMENT OF HEALTH. Bulletin No. 9. Department of Industrial Medicine, Northwestern University Medical School. Chicago: Northwestern University, 1939. 56 pp. Price, $2.00.

HEALTH PLAYS FOR CHILDREN. By Ella B. Johnson, Clarence M. Lindsay and Others. Chicago: Beckley-Cardy, 1938. 112 pp. Price, $.40.

PUBLIC HEALTH IN THE STATE AND COUNTIES OF VIRGINIA. By J. F. Kendrick. Department of Health, Richmond, 1939. 105 pp.

BOOKS FOR THE ADULT BLIND, INCLUDING THE TALKING-BOOK MACHINE ACTIVITY AND SERVICE FOR THE BLIND. From the Annual Reports 1937–1938. Washington; Government Printing Office, 1939. 71 pp.

CANNED FOOD REFERENCE MANUAL. New York: American Can Company, 1939. 242 pp.

MUELLER BRIDGES FOR HIGHLY PRECISE MEASUREMENTS OF TEMPERATURE. Catalog E-33C(1), 1939. Philadelphia: Leeds & Northrup, 1939. 16 pp.

MACMILLAN'S MODERN DICTIONARY. Compiled and Edited under the Supervision of Bruce Overton. New York: Macmillan, 1938. 1466 pp. Price, $3.00; with thumb index, $3.50.

NURSING IN SICKNESS AND HEALTH. The Social Aspects of Nursing. By Harriet Frost. New York: Macmillan, 1939. 217 pp. Price, $2.00.

A COLLEGE COURSE IN HYGIENE. By K. Frances Scott. New York: Macmillan, 1939. 202 pp. Price, $2.50.

HOUSING FOR THE MACHINE AGE. By Clarence Arthur Perry. Revised Edition. New York: Russell Sage, 1939. 261 pp. Price, $2.50.

HOUSING THE MASSES. By Carol Aronovici. New York: Wiley, 1939. 291 pp. Price, $3.50.

NUTRITION. By Margaret S. Chaney and Margaret Ahlborn. Revised Edition. New York: Houghton Mifflin, 1939. 436 pp. Price, $3.00.

MEDICAL RESEARCH COUNCIL. Report on Radium Beam Therapy Research, 1934–38. By Constance A. P. Wood, L. G. Grimmett, T. A. Green and Others. London: His Majesty's Stationery Office, 1938. 77 pp. Price, $1.20.

ALCOHOL. ITS ACTION ON THE HUMAN ORGANISM. By a Committee originally appointed by the Central Control Board (Liquor Traffic) and later reconstituted by the Medical Research Council. Third Edition, Revised. London: His Majesty's Stationery Office, 1938. 176 pp. Price, $.30.

LABORATORY GLASS BLOWING WITH PYREX BRAND GLASS. Corning, N. Y.: Corning Glass Works (Laboratory and Pharmaceutical Division), 1938. 20 pp. Free upon request to users of Corning laboratory glassware.

# A SELECTED PUBLIC HEALTH BIBLIOGRAPHY WITH ANNOTATIONS

RAYMOND S. PATTERSON, PH.D.

**British Health Services**—According to this author, 3,600,000 plus new homes have been provided in slum clearance schemes and every third family lives in a post-war house. Yet, he says, the speed at which some local authorities have tackled slum clearance has varied between dead slow and dead stop. How would he characterize the feeble American efforts in this direction?

ASBURY, W. The Future of Public Health Services. J. Roy. San. Inst. 59, 12:727 (June), 1939.

**In the Spring of 1839**—Many other interests are making publicity capital from baseball's hundredth anniversary, so there seems to be no reason why public health shouldn't have an inning. The story of the centennial of Abner Doubleday's game will entertain us one and all.

CASWELL, J. E. Baseball 100 Years Ago. J. Health & Phys. Ed. 10, 5:278 (May), 1939.

**Rickettsiae Vaccines from Chick Embryos**—Enough vaccine to immunize 135 persons against spotted fever can be cultured on a chick embryo. The vaccine thus prepared has been found effective for guinea pigs.

COX, H. R. Rocky Mountain Spotted Fever. Pub. Health Rep. 54, 24:1070 (June 16), 1939.

**Getting Medical Advice**—In sampling low income groups in New York City, a researcher asked 365 self-supporting families about how and where they got their medical services. Her findings suggest that in this group, at least, the free choice of doctors usually isn't very free and the choice is rarely very wise.

DAVIS, M. M. A Doctor of Their Choice. Survey Graphic. 28, 7:431 (July), 1939.

**Water Supplies and Caries**—In two cities in Illinois there are enough fluorides in the drinking water to cause a mild degree of dental mottling. In two nearby cities the water is almost free of fluorides. Children twelve to fourteen years old in the first two cities have less than half the incidence of dental caries than have similar groups of children in the cities with water free from fluorides. There was no discernable difference in the saliva of the children in the various cities, but the difference in oral lactobacilli reflected the differences in carious teeth. This paper should be on your "must" reading list.

DEAN, H. T., *et al.* Domestic Water and Dental Caries, Including Certain Epidemiological Aspects of Oral *L. acidophilus*. Pub. Health Rep. 54, 21:862 (May 26), 1939.

**"The Nurse Says"**—Public health nursing will be vastly improved in general when these factors (among others) are bettered: clinic services that do not belie the nurse's promises to the patient; complete and adequate histories on all patients before visiting; better distribution of community nursing resources; and actual services when needed—not merely advice. This is another of the interesting verbatim reports on what the nurse said to the patient and vice versa.

DERRYBERRY, M. Administrative Procedures that Interfere with Effective Public Health Nursing. Health Officer. 4, 1:18 (May), 1939.

**Intracutaneous Smallpox Vaccination**—Calf lymph virus gave a slightly higher percentage of takes than did

intracutaneous vaccination with chick virus, but severe reactions were less frequent with the latter. There was little difference in the scar.

ELLIS, R. W., and BOYNTON, R. E. Smallpox Vaccination: A Comparison of Vaccines and Techniques. Pub. Health Rep. 54, 23:1012 (June 9), 1939.

**The New Public Health**—This paper urges the creation of a unified, all-embracing federal health agency with a cabinet secretary at its head, empowered to administer grants-in-aid to disadvantaged parts of the country, to conduct research in administrative needs, and to inspire adequate public health education in its broad sense, but not to coerce local governments into the practice of general curative medicine.

EMERSON, H. Administrative Medicine. N. Y. State J. Med. 39, 11:1055 (June 1), 1939.

**Who Gets Good Prenatal Care**—Three-quarters of the women in comfortable circumstances (in certain Michigan districts) received prenatal care, whereas three-quarters of those in the underprivileged group didn't. City women had better care than rural. This is not a surprising statistic to students of social sciences, but it may be useful evidence of an accepted assumption.

GODDARD, J. C., and PALMER, C. E. Maternal Services in Michigan with Special Reference to Economic Status. Pub. Health Rep. 54, 20:825 (May 19), 1939.

**Genes and Viruses**—Reporting to the informed laity upon the chemistry of the tobacco mosaic virus, the author gives an excellently clear picture of what science has discovered in that borderland where life begins. The paper will entertain and inform health workers, even those whose knowledge of biochemistry is elementary.

HUNT, W. R. "Whence Cometh Life." Sci. Month. 48, 9:550 (June 3), 1939.

**Pros and Cons Re Blood Tests**—Ten good reasons for requiring premarital blood tests for syphilis and four weak ones against. Five strong reasons for requiring blood tests during pregnancy or at delivery and none, of any kind, against. Score: both tests win!

KOLMER, J. A. Laws Requiring Premarital and Pregnancy Tests for Syphilis. J.A.M.A. 112, 23:2385 (June 10), 1939.

**British Health and Medicine**—It takes a conservative Briton to show how radical are we here in this wild and wooly America. The R. E. P. report quietly commends the proposal that medical services, like education, should be free to all. This writer urges that all health and medical services be unified and that the M. O. H. be put at the helm.

MILLIGAN, E. H. M. Medicine and Public Health. Pub. Health. 52, 9:266 (June), 1939.

**England Studies Industrial Health Hazards**—Some swell quotations from Ecclesiasticus introduce this British discussion of industrial hygiene. Listen to these sage comments upon: (hours) "every carpenter and workman that worketh night and day . . ."; (diseases) . . . "the vapor of the fire wasteth his flesh, and he fighteth with the heat of the furnace"; (repetitive work) "so doth the potter sitting at his work and turning the wheel about with his feet; who is always carefully set at his work, and maketh all his work by number"; (housing) . . . "and they shall not dwell where they will nor go up and down."

MUNRO, D. Industrial Health Research. J. Roy. San. Inst. 59, 12:717 (June), 1939.

**Statesmanship in Public Hygiene**—It is devoutly to be hoped that every complacent health worker—and others too—will take this paper into his little corner to ponder over with open mind.

The temptation to quote many of the arresting statements of facts that we all should know is well-nigh irresistible.

PARRAN, T. Health Needs of the Nation. Pub. Health Rep. 54, 22:919 (June 2), 1939.

**Three Dimensional Graphs**—Acetone vapor inhaled by guinea pigs affects temperature and respiration as concentration increases. The findings of this study will be of greatest moment to industrial hygienists, but all health educators—and what health worker isn't—will be interested in the three dimensional graphs which reveal these findings.

SPECHT, H., *et al.* Acute Response of Guinea Pigs to the Inhalation of Demethyl Ketone (Acetone) Vapor in Air. Pub. Health Rep. 54, 22:944 (June 2), 1939.

**Dose To Be Taken Every Hour**—We are pleased to assume that American plumbing is the wonder of the world. A blaster of pet delusions reminds us of some of the water-borne disease outbreaks that have resulted because we are so well satisfied with ourselves and our plumbing.

STEARNS, M. M. The Hazard of Faulty Plumbing. Survey Graphic. 28, 6:382 (June), 1939.

**Hypertensive Arterial Disease**—Here is an excellent discussion of the predisposing and the provoking factors that produce high blood pressure. Worrying, ambition, and inability to relax, traits that contribute to fatigue, predispose. Infections and numerous poisons provoke. The disorder is controllable rather than curable. Periodic examinations are needed to discover it early enough for hopeful treatment.

STIEGLITZ, E. J. High Blood Pressure. Sci. Month. 49, 1:35 (July), 1939.

**T. B. in the Teens**—Bed rest alone does not modify the spreading of tuberculous lesions in youngsters in the second decade, nor does it reduce the mortality. Therapy doesn't effect the mortality in advanced lesions. The prognosis of soft early lesions is uncertain for ten years. Health educators should realize the import of these findings even though they are to continue to teach that early discovery means early recovery.

ZACKS, D. Pulmonary Tuberculosis in the Second Decade of Life. Am. Rev. Tuberc. 39, 6:683 (June), 1939.

# Previewing Pittsburgh's Science Centers

BUSTLING Pittsburgh, scene of the 68th Annual Meeting of the American Public Health Association in October, is a world center of chemical, engineering, and medical research. Not only is it the home of five institutions of higher learning and 38 hospitals, but also it boasts dozens of industrial laboratories in which new trails are blazed in technology, speeding the forward march of man.

The Committee on Scientific Trips has surveyed the rich field for tours and has made a comprehensive selection of the institutions, plants and laboratories for inspection by organized large groups of convention guests. In addition to the official tours, members will be able to make their own special arrangements to visit other local points of individual interest.

But meanwhile, the Publicity and Scientific Trips Committees will endeavor, in some small way, to give delegates a "preview" of points to be covered in scientific trips.

*Air Hygiene Foundation*—This organization represents a collective, scientific effort upon the part of some 250 industrial concerns for the advancement of industrial health. The Foundation, a non-profit corporation, maintains its headquarters and a Multiple Fellowship at Mellon Institute. It also makes research grants to the Saranac (N. Y.) Laboratory, Harvard School of Public Health, and University of Pennsylvania for studies and investigations in industrial hygiene. For instance, the Foundation recently issued a report to its member companies on the results of an X-ray research. Companies large and small, in all lines of the "heavy" industries, have joined in this combined effort upon the part of employers in behalf of employee health.

Convention guests will have the opportunity of learning in detail about the work of the Foundation through its exhibits at Mellon Institute and at Convention Headquarters.

*Aluminum Cooking Utensil Company*—The New Kensington works of the Aluminum Company of America is the largest aluminum cooking utensil plant in the country.

The Aluminum Company had its origin in the Pittsburgh Reduction Company, which was founded in 1888 for the purpose of manufacturing aluminum by the Hall process. For several years it occupied a location on Smallman Street, Pittsburgh. Later it was moved to New Kensington, 18 miles up the Allegheny River.

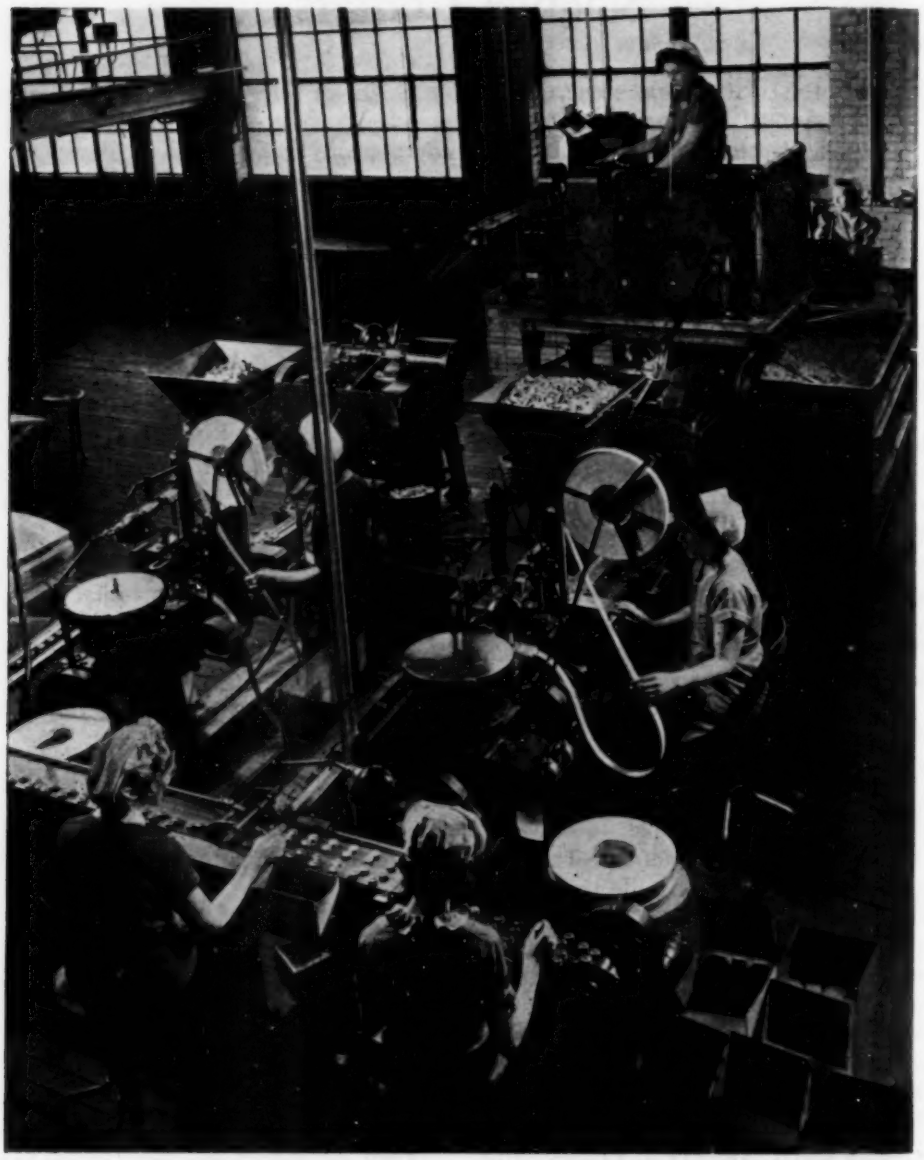
The New Kensington plant is principally known for the manufacture of aluminum cooking utensils. In addition to the manufacture of such articles, visitors will see the rolling of aluminum sheet.

After the guests have completed their tour through the cooking utensil mill, they will be escorted to the Aluminum Research Laboratories, also located in New Kensington and noted as the largest aluminum research laboratories in the world.

Then the guests will have an opportunity to see, at close range, the world's most powerful testing machine, which, it is hoped, will be in operation by October 17.

Large extrusion presses make mold-

ings, trim, and other architectural shapes. This is a most interesting operation. A billet of aluminum is placed in the presses back of a die, and the pressure from the presses force the aluminum through the die in any desired shape. The metal comes out of the press like tooth paste from a tube. Strong aluminum alloy sheet also is made here. This is the sheet that goes



New universal unit for the manufacture of aluminum bottle closures. The caps are first blanked from sheet (upper right), then conveyed to units for trimming and beading. Liners are inserted, and the caps are carried on belts to the inspectors (lower left), who examine both inside and outside of each cap. The machine is capable of producing up to 5,000 finished pieces an hour.

into the manufacture of airplanes and other structures where high strength combined with lightness is essential.

Great activity is to be found in the seal mill, where bottle caps and closures are made for innumerable products. Another important division is the foil mill, where aluminum foil is made for such purposes as milk bottle caps, wrappers for butter, cheese, tobacco, cigarettes, chewing gum, and candy. This foil can be colored, printed, and embossed, so that thousands of attractive patterns are available.

These commodities give some indication of the widespread use of aluminum, which, in a little more than fifty years, has gone from a laboratory curiosity to a material which is fourth in point of volume used among all metals.

*City Filtration Plant* — The city filtration plant is located in Aspinwall, a suburb of Pittsburgh, about 8 miles from the city limits. It consists of 60 acres of filter beds all underground. The only surface indication of any activity is the general office and the pumping station along the river bank nearby. The water is pumped from the Allegheny River to a settling basin where the heavier impurities are deposited. It then flows by gravity to one of sixty filter rooms each approximately one acre in area. These rooms are about 10 feet high, with a concrete roof, over which is a 3 foot layer of soil. The floor of the room consists of a layer of sand several feet thick through which the water passes. After the water has passed through, the top two or three inches of sand are removed and washed to remove impurities, and then redeposited on the floor.

The filtered water flows by gravity

A dust determination in the course of a study by Air Hygiene Foundation.

back to the pumping station at the river bank, and it is then pumped to the Highland Park reservoir several miles distant for distribution throughout the city.

*H. J. Heinz Company*—The plant we will visit is the largest food products manufacturing establishment of its kind in the world. Its " 57 " varieties are used on millions of tables both in this country and in foreign lands.

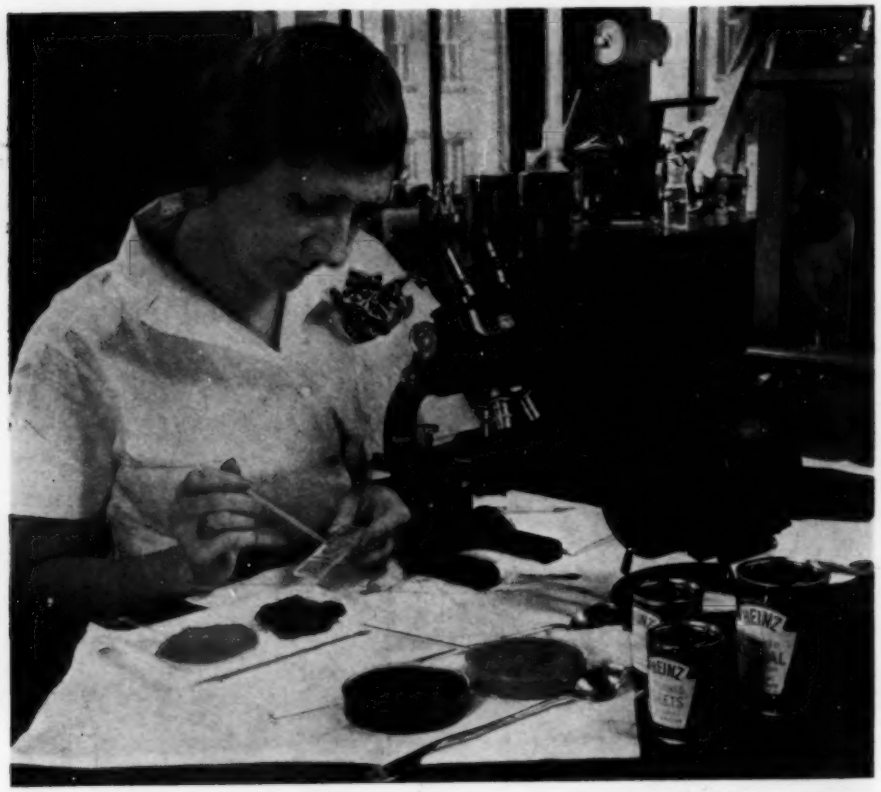
Uniformed guides will conduct the group through the plant, showing visitors the preparation, closely supervised, of vegetables and fruits for canning and preserving. Great care is taken to insure the purity and quality of Heinz products.

Visitors will see the bottling department for pickles. Here the pickles are graded, sorted, and bottled without ever being touched by human hands. Pickles are all bottled by hand labor, but the girls use wooden forks and spoons to handle the food.

The Heinz plant also has its own can manufacturing department. Machines cut, trim, roll, and form the metal, and then seal the bottom of the can, all in one operation.

*Hospitals in the Pittsburgh Area*—In addition to tours to industrial research laboratories and plants, arrangements are being made for a series of visits to various hospitals, particularly to those in which research is being conducted on public health problems.

*Jones and Laughlin Steel Corpora-*




Quality control is constant. The testing begins with raw materials for only the choicest are used. The preparation of foods is under scientific control. Heinz scientists are constantly looking for new and better ways to prepare food.

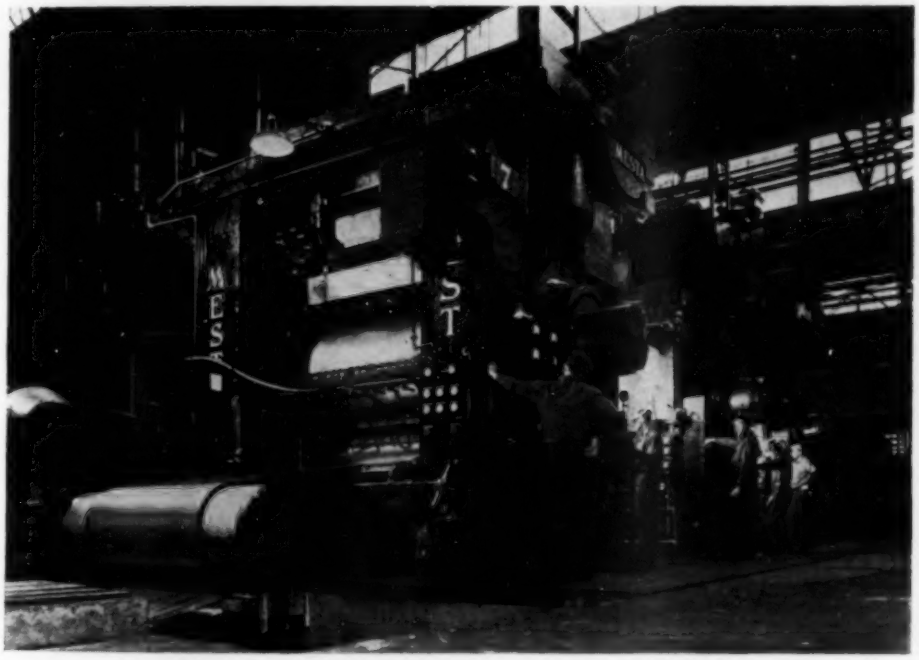
*tion*—The 96 inch continuous strip mill of the Jones and Laughlin Steel Corporation has been in operation a little over 2 years. It is located on a site of more than 23 acres between the Monongahela River and Second Avenue not far from the business section of Pittsburgh. It extends along the river for a little less than one-half mile.

Slabs for the mill are furnished from the new blooming mill installed directly across the river. Railroad cars of special design are provided to transport the hot slabs across the river.

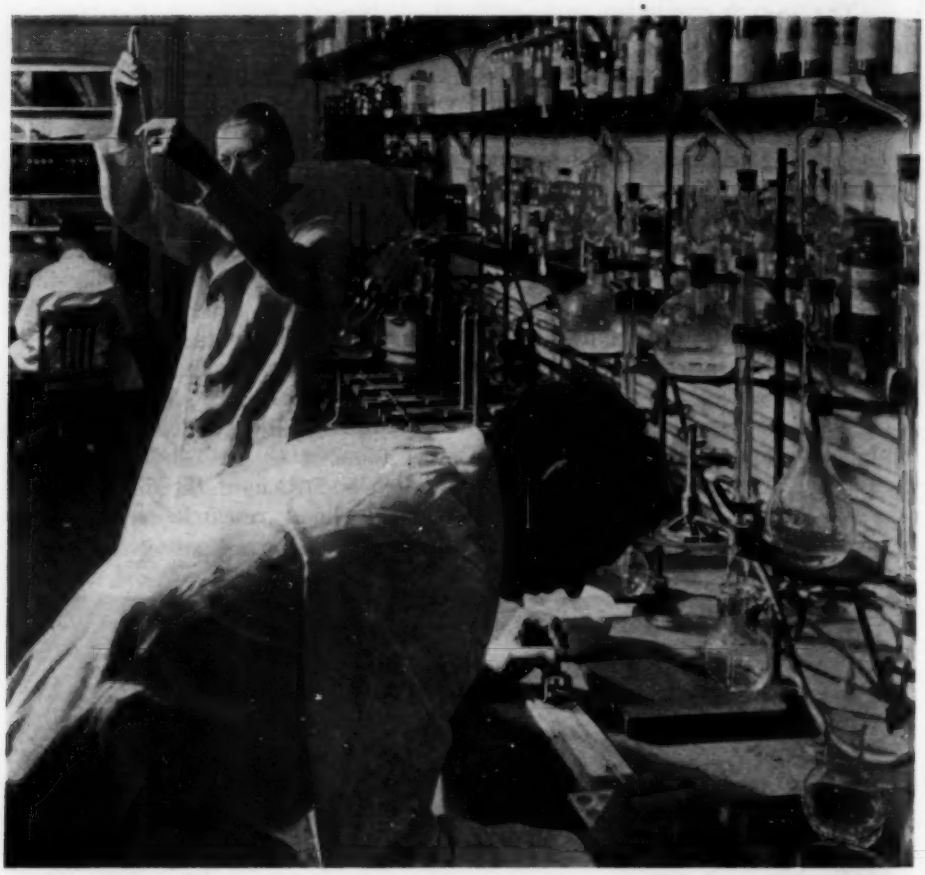
The slab is passed into one of three continuous heating furnaces at temperatures of 2,150–2,250° F. It then passes to the hot mill where the rolling begins; it is reduced in thickness and the ultimate width of the finished product is established. At the end of this operation the slab is cut into sheets or rolled into coils.

In this mill there are also a blue annealing department, coil pickling building, cold rolling mill, box annealing furnaces, cold finishing operation, and a galvanizing department. This galvanizing unit is set up to handle sheets up to 60 inches wide and 180 inches long. Black sheets are given a coating of hot zinc and carefully inspected by trained operators.

*Mellon Institute*—This institution was founded in 1913 by Andrew W. Mellon and Richard B. Mellon to provide qualified research workers with facilities for investigating thoroughly



Some of the most important finishing operations of the J. & L. 96 inch continuous strip mill take place in the cold rolling department. In this department, the strip and sheets rolled on the hot mill are given another rolling or reduction which imparts to them the finest surface finish and the proper physical characteristics. Much of the steel rolled on this mill will ultimately be formed into automobile bodies, air conditioning equipment, stoves, refrigerators, and such other products which require highly finished surfaces. The mill above is the 93 inch three tandem, four-high cold rolling mill.



Activities in the biochemical laboratory of the Meat Merchandising Fellowship at Mellon Institute, following experimental tenderizing involving special attention to enzymes.

important problems of pure and applied science. The Institute is primarily concerned in carrying on broad studies of post-doctoral character supported by persons or organizations interested in these fields of research.

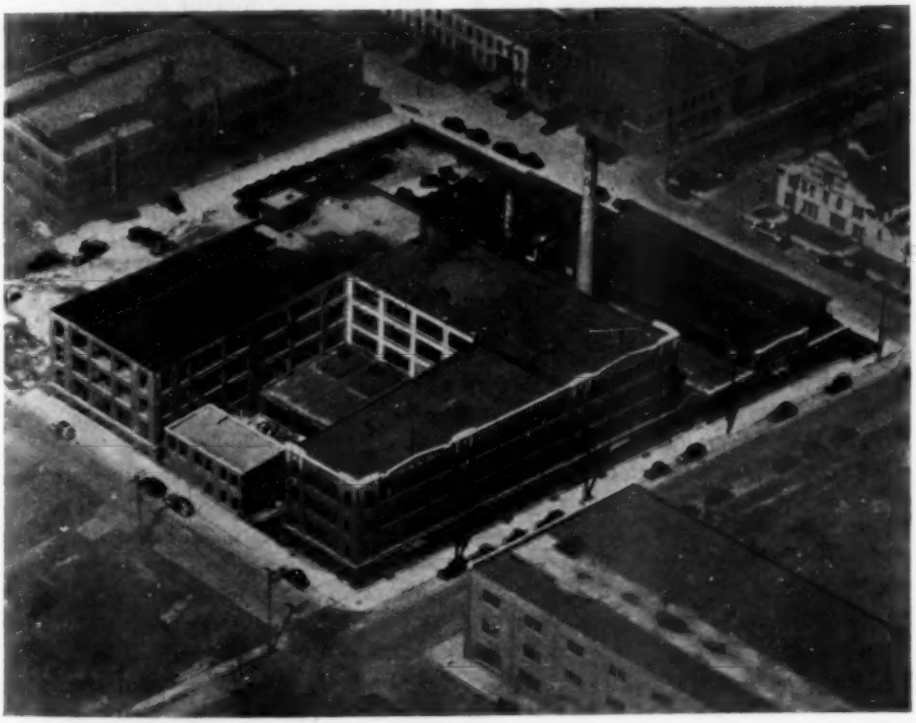
The Institute's many investigations in the realm of pure science include studies on urban smoke abatement and industrial dusts, a comprehensive research on sleep, an investigation of the cause and prevention of dental caries, a project to find a better way to diagnose tuberculosis in its early stages, and a search for new compounds of value in treating pneumonia.

The industrial research of the institution is organized on a contract basis. The problem is set by a person, firm, or association, the scientific worker is engaged by the Institute, and an Industrial Fellowship is assigned for a period of at least one year. Each incumbent of an Industrial Fellowship is given the broadest facilities for accomplishing a definite piece of research; all results obtained by him belong exclusively to the donor of the Fellowship. Only one investigation is carried out on a particular subject at any one time, and hence there is no duplication of the research activities of the Fellowships in operation.

At present 80 Fellowships are active,

*Courtesy of U. S. Bureau of Mines*

This is a rock dusting machine at work in a mine "spraying" limestone dust which helps prevent dust explosions. Limestone is an inert dust, not regarded as harmful to health.



A view of the plant of the Mine Safety Appliances Company.

requiring the services of 240 scientists and engineers. During the 27 years since the foundation of the institution nearly 4,000 American companies have been served on problems ranging from glass and steel to food and textiles. The organization has evolved many novel products and processes, some of which have resulted in the formation of entirely new industries. Since 1911 more than $13,000,000 has been contributed to the Institute by Industrial Fellowship donors.

In May, 1937, the Institute dedicated its new building, an imposing edifice whose most distinctive architectural feature is a colonnade of massive monolithic columns. The cubage of the structure is 6,500,000 cu. ft. It is one of the most beautiful and best equipped research laboratories in the world.

Tours through the building will cover all essential features of the institution, including its beautiful general rooms, its excellent technical library of 16,000 volumes, its efficient laboratories, and its engineering and development division. The trip will be made under trained guides who will describe in detail the operating principles of the Institute as well as the various research projects that are in operation.

*Mine Safety Appliances Company*—This is the largest manufacturing plant in the world devoted to the production of safety equipment. Originally founded to supply safety devices to the mining industry, it has pioneered in the development of a wide line of apparatus for general industrial safety. Much of this equipment is of considerable interest to public health officials, the medical profession, and specialists in the industrial hygiene field.

Gas and dust instruments form an interesting group of MSA products. By means of these instruments flammable or toxic gas concentrations can be detected and in some cases recorded.

The Westinghouse "Atom-Smasher" with which research physicists conduct experiments at the East Pittsburgh Laboratories in the field of nuclear physics.

Most of the long vehicular tunnels in this country use MSA instruments to sample continuously and control the carbon monoxide concentration. The MSA dust instruments and equipment, although on the market for only a short time, have found ready acceptance in mines and plants for the determination of dust in the atmosphere.

During the last few years the MSA Research Laboratories have made a study of silicosis and other respiratory diseases and means of protection against them. The result of this work is the MSA Comfo Respirator, the first dust respirator officially approved by the U. S. Bureau of Mines.

First aid training of mine and industrial workers has become quite common today, and MSA First Aid Equipment has gone hand in hand with the movement; special pocket packets, first aid cabinets of all kinds, stretchers, burn treatments, finger bandages, etc., are offered. One whole floor of the MSA plant is given over entirely to the manufacture of this type of material.

Other MSA equipment includes gas masks, breathing apparatus, head and eye protectors, and safety clothing.

*Experimental Mine, U. S. Bureau of Mines*—Thirteen miles from Pittsburgh is the Experimental Mine and Explosives Testing Station of the U. S. Bureau of Mines.

When the Bureau of Mines was organized in 1910, one of the important lines of investigation was the explosion of coal dust which had wrecked so many mines and killed so many men. To simulate actual conditions a tract of land underlaid with an undeveloped coal deposit was procured and the Experimental Mine was started.

The Mine consists of twin tunnels or entries driven in the coal for a distance of 1,300 feet, and two side entries in which rooms have been driven. Here actual explosions of coal dust are set off to show that rock dust is the most reliable means of preventing and controlling coal dust explosions. Here also explosives are tested for their value and permissibility in coal mine use.

*Westinghouse Electric and Manufacturing Company*—The Westinghouse Electric and Manufacturing Company is one of the most prominent in the electrical machinery field. Its products are widely used in all parts of the world. The company's plant at East Pittsburgh occupies approximately 14,000,000 square feet and employs many thousands of people.

The public utility industry is dependent on Westinghouse Electric for machinery for production, transmission, and utilization of electric power. Besides this heavier equipment the company also produces a complete line of electrical appliances for home use.

The East Pittsburgh plant manufactures a plastic insulating material known as Micarta, which has found application in many other industries, such as greaseless bearings, tunnel linings, and in place of wood.

The research department has pioneered in the field of electricity and radio and now has its own four story building entirely separate from the rest of the plant. This department is now conducting an extensive search in radioactivity and the structure of the atom. The company is noted for its work in industrial hygiene. It maintains extensive medical facilities which include an industrial hygiene laboratory.

# The Scientific Program 68th Annual Meeting—Pittsburgh

THE Pittsburgh Annual Meeting, the 68th, lies just ahead.

The Section Secretaries and the Program Committee are now ready, after weeks of preparation and planing, to announce the results of their efforts in program building. Their aim has been to present to the health workers who will gather in Pittsburgh the most significant and promising of the newer developments in health services for the public and to bring these selected topics forward under the best possible auspices.

The program has been developed primarily around the interests of the ten Sections of the Association. There are in addition attempts at general orientation with the contemporary public health scene and experimental reconnoiterings in borderlands not yet officially ceded to a public health protectorate.

A resumé of the program is given here in lieu of the usual listing of subjects and speakers.

## ADVANCE MEETINGS

While the dates of the Annual Meeting are announced as October 17–20, the convention actually gets under way on Sunday morning, October 15, with the opening of the Sixth Institute on Public Health Education. Its theme is "Health Education for Three-thirds of a Nation." Dr. Ira V. Hiscock is Chairman and he has assembled a faculty representative of the most progressive thinking and performance in the field of mass education for health. He is assisted by Drs. Gruenberg, Kleinschmidt, Galdston, Patterson, Gebhard, Bauer, Cornely, Otto, Baumgartner, Shepard, Derryberry, Halverson, Walker, Morgan, Turner, and Leavell; by Messrs. Grimley, McCandless, Widdemer, Resnick, Dent, Marquette, and Broughton; and by Miss Grout, Miss Connolly, Miss Shaw, Miss Strachan, Miss Harris, and Miss Davis.

Small discussion groups are emphasized on such subjects as the spoken word, the radio, the newspaper, printed matter, exhibits, motion pictures, personal contacts and visual methods, program planning, school health education. There is a general session on how to reach professional, lay and student groups; one on how to appraise health education content and materials; one on organizing a coördinated health education program.

The Institute runs all day Sunday, all day Monday, and Tuesday morning. It is open to anyone engaged in or interested in health education. The registration fee is $3.00 for Association members and $6.00 for all others. The complete program is available on request to the Association office.

The International Society of Medical Health Officers will sponsor an Institute for Health Officers on Monday, October 17, with morning and afternoon sessions devoted to informal discussion of practical administrative problems. They join the students and faculty of the Health Education Institute at luncheon, and they have

planned a dinner for that evening with accent upon fun and sociability.

Five Conference groups will meet on Monday: State Laboratory Directors, State Sanitary Engineers, Municipal Public Health Engineers, Directors of Local Health Service and State Directors of Public Health Nursing.

The Association of Women in Public Health will hold a meeting Monday morning to consider the opportunities open to women planning a public health career. This will be followed by a luncheon, open to the public, with a well known newspaper man and an outstanding educator as speakers.

The National Organization for Public Health Nursing is joining with the American Public Health Association at its Annual Meeting, celebrating this event with a dinner on Monday evening. Dr. Winslow presides and Katharine Tucker speaks on "Preparation for Public Health Nursing—How, Where, When?"

The American School Health Association must be listed among advance meetings because its first and second sessions are held on Monday, although it continues throughout the week with joint meetings with Association Sections, sponsors a luncheon session on tuberculosis on Thursday, a session on school health policies on Thursday afternoon, and winds up on Friday morning with a summary of the special contributions of the 68th Annual Meeting to the school health program.

This Association's Monday afternoon program offers J. Louis Neff speaking on medical resources for the care of school children and Mellie F. Palmer, R.N., with the provocative title "Coöperative-Planning — A Dynamic for School Nursing." The Monday evening meeting presents Dr. B. B. Bagley, Dr. Fredrika Moore, and Dr. Helen A. Cary. Dr. Bagley answers the question "How can the state department help improve school health procedures?" Dr. Moore indicates what should be attempted in school health work on a limited budget and Dr. Cary explains the part of the school physician in effective follow-up.

### GENERAL SESSIONS

Six opportunities for entire Association participation are provided this year with programs that cut across all Section boundaries and that are of interest and concern to every member and guest.

Two evening general sessions are scheduled. On Tuesday evening, Dr. Edward S. Godfrey, Jr., will present his Presidential Address. The second speaker, Dr. Milton J. Rosenau, inaugurates the Delta Omega Lectureship with a philosophical essay entitled "New Lamps for Old." The second evening general session will be held on Thursday in the form of the Annual Banquet.

A session on Medical Care has been arranged for Wednesday afternoon with discussions on medical care as a welfare function and as a public health function.

On Wednesday, Thursday, and Friday mornings, Section meetings will be dismissed at 11:15 to permit attendance at general sessions of one hour duration. The subjects considered by the Program Committee of sufficient importance to engage the attention of all delegates are "The American Way as Seen from Abroad" with contributions from distinguished visitors from overseas, "Cancer," and "Professional Education."

### JOINT SESSIONS

The Child Hygiene and Public Health Nursing Sections and the American School Health Association come together to consider the physical and emotional development of the adolescent with the implications that each has for the general health program and the

school health program. William Greulich, Ph.D., Caroline Zachry, and Lawrence K. Frank are the speakers, with the nursing interests represented by Hortense Hilbert, R.N.

The Child Hygiene Section figures also in a joint meeting on dental health with the American School Health Association and the Oral Health Group and further with the Public Health Education Section and the American School Health Association in a session on "The Educational Psychology Underlying the Motivation of the Individual." This is attacked at the elementary school level by Dr. James F. Rogers, at the secondary school level by Philip L. Riley, and at the adult level by Raymond H. Greenman.

The Health Officers and the Industrial Hygiene Sections sponsor a symposium on illness in industry and its control. Dr. C. H. Kibbey tells of a quarter century with an industrial health department; Dr. Anthony J. Lanza talks on tuberculosis in industry; Dr. Clarence D. Selby shows how industry can approach adult health problems, and Dr. Carl A. Wilzbach contributes a paper on the control of syphilis in industry.

The administrators collaborate with the educators in one session, the Health Officers represented by Dr. I. C. Riggin and Dr. George T. Palmer, the Public Health Education Section by Professor C. E. Turner, Savel Zimand, and Dr. Leona Baumgartner.

Pneumonia receives attention at the hands of the Health Officers and the Epidemiology Sections in a symposium in which Dr. Lloyd D. Felton, Dr. Wheelan D. Sutliff, Dr. Wilson G. Smillie, and Dr. Ernest L. Stebbins are taking part.

Miscellaneous problems which depend for their solution upon coöperation between the health officer and the public health engineer, such as hygiene of swimming, restaurant sanitation, and automatic control of pasteurization, are considered in a joint session of the Health Officers and Public Health Engineering Sections. The speakers are Dr. H. Marshall Long, H. H. Wagenhals, A. W. Fuchs, and Sol Pincus.

The engineers hold their customary joint session with the Conference of State Sanitary Engineers. The subjects include training of water works operators, standards for bathing places, sanitary land-fills, the National Plumbing Laboratory, and functions of public health engineering personnel, with speakers as follows: Anselmo F. Dappert, Warren J. Scott, Lewis V. Carpenter, Francis M. Dawson, and Roy J. Morton.

A symposium on engineering problems in industrial hygiene involves the engineers and the industrial hygienists. B. F. Postman discusses exhaust ventilation and occupational exposures; J. M. Dalla Valle, M.D., voices the principles of industrial sanitation; J. M. Graves, M.D., suggests methods for integrating industrial hygiene with local health service, and W. Scott Johnson proposes an administrative approach to the engineering phases of industrial hygiene.

The Laboratory and Food and Nutrition Sections combine once for a consideration of food poisoning with such experts on the platform as Fred W. Tanner, T. D. Nunheimer, and Glenn G. Slocum, and again in a session on dairy products where the methylene blue and the Resazurin tests are compared for results, constant temperature incubation in milk control work is stressed, and pasteurization efficiency is examined. Lawrence Little, Robert S. Breed, Ph.D., Harold W. Leahy, Harry Scharer, and E. H. Parfitt appear on this program.

Gastroenteritis is given an entire session by the Laboratory and Epidemiology Sections. The newer knowledge of bacillary dysentery and other

intestinal infections is summarized by Joseph Felsen, M.D. An outbreak of Shiga dysentery and outbreaks of gastroenteritis of unknown etiology are described respectively by Berneta Block, M.D., and Millard Knowlton, M.D. Albert V. Hardy, M.D., has a paper on the "Newcastle Dysentery Bacillus" and Marion B. Coleman one on differentiation and identification of bacillary incitants of dysentery.

The Food and Nutrition and Child Hygiene Sections and the American School Health Association spend a half-day on the subject of nutrition. William Schmidt, M.D., George M. Wheatley, M.D., Lynda M. Weber, and C. C. Hudson, M.D., are among the names on this program. Their presentations deal with the appraisal of nutritional status by newer medical methods, the care of undernourished children, teaching nutrition in high schools, and the school lunch.

### THE SECTION PROGRAMS

The 12 joint and 6 general sessions already described and the many advance meetings would seem to offer a full week's work for the avid seeker after knowledge. The independent meetings of the ten Sections provide competition of high order, however, and offer opportunities for the specialist to get down to fundamentals.

*Health Officers.* "Promising Additions to Health Department Programs," "Personnel Problems," and "Venereal Diseases" are the titles of the three independent sessions of this Section.

In the first, Drs. J. N. Baker, K. E. Miller, George C. Ruhland, and Ralph C. Williams discuss respectively farm and home accidents, advertising control of foods, drugs, cosmetics and devices, hospitals in a public health program, and medical care plans for low income farm families.

In the second, prevailing employment policies in health departments are summarized by Dr. M. V. Zeigler, personnel administration under civil service is described by Dr. George T. Palmer, lessons that may be learned from personnel administration in industry are pointed out by S. J. Fosdick, and Dr. Mayhew Derryberry reports on a study of educational qualifications of staff members in health departments.

The symposium on venereal diseases has as its contributors Dr. Nels A. Nelson, Dr. John H. Stokes, Mary Hooke Goodwin, Dr. P. S. Pelouze, and Dr. Theodore Rosenthal. Their subjects, in the order of the speakers listed, are: Why don't we stamp out gonorrhea?; A study of consultation on syphilis by correspondence; The advantage of the family clinic in the prevention and control of syphilis; The control of gonococcal infection and syphilis among domestic servants.

*Laboratory.* The first session is given over to reports of Standard Methods Committees. The Laboratory Section is the breeding ground for some of the most significant of the Association's work and these reports of research accomplished and in progress have important implications for all health workers. They include water and sewage, dairy and food products, diagnostic procedures and reagents, biology of the laboratory animal, frozen desserts, biological products, and shellfish.

One session is devoted to the newer venereal diseases. Dr. E. S. Sanderson describes the laboratory aspects of chancroid, granuloma venereum and lymphogranuloma venereum, and Dr. Fred Wise discusses and illustrates the differential diagnosis of these diseases. Dr. Joseph R. D'Aunoy gives detailed consideration to the last named, and Dr. Robert B. Greenblatt takes the broad view in a paper on aspects of all the newer venereal diseases.

The biology of the laboratory animal receives attention at the hands of Dr. R. G. Daggs, Dr. Gregory Pincus, Dr.

Paul B. Sawin, Dr. Paul A. Moody, Dr. Norman J. Pyle, Captain Ralph W. Mohri, and Lt. Col. Raymond A. Kelser.

Two sessions of miscellaneous titles complete the Laboratory program. The papers deal with reasonably priced incubators, rabies, gonococcus carriers, effect of chemical antisepsis on phagocytosis, heat resistance of streptococci, oral contamination of drinking glasses, slow lactose fermenting coliform organisms, *E. typhosus* in soils, laboratory diagnosis of enteric diseases, and toxicity of basic fuchsin for certain diseases. The speakers are: Lt. Col. A. Parker Hitchens, Dr. Charles N. Leach, Dr. Charles M. Carpenter, Dr. Henry Welch, Dr. Edward C. Rosenow, Leo Dick, Dr. Charles A. Stuart, Dr. Paul J. Beard, Dr. Joseph A. Kasper, Catherine Mayfield, and Cassandra Ritter.

*Vital Statistics.* Four independent meetings containing a total of twenty papers and reports reveal the present interests of statisticians. Five papers are grouped in a symposium on the coördination of vital statistics with the expanding programs for social welfare. They cover record keeping for venereal diseases; hospital morbidity reporting: statistical needs of maternal and child health organizations as related to county and state programs; the relationship of the work of the Social Security Board to that of the state, city and local registrars, and the broader aspects of the coördination of vital statistics with the expanding programs for social welfare. Lida J. Usilton, Dr. Helen Jeter, Dr. Edwin F. Daily, Willard C. Smith, and Dr. Lowell J. Reed are the speakers.

Other topics and speakers are: Exhibit technics in vital statistics at the New York World's Fair, Jacob Baar; Publicity in promoting registration of births and deaths, Dr. Martin B. Woodward; Educating medical students and others concerned with registration data, I. C. Plummer; Reflections on fatality rates for reported cases of tuberculosis, Dr. Gaius E. Harmon; Evaluation of the Massachusetts state-aided cancer clinics, Eleanor J. MacDonald; Tabulating associated causes of death, Theodore A. Janssen; Experiences with the new forms of certificates, Thomas W. Chamberlain; Reliability of statistics on cause of death, Robert G. Webster; Plans for the 1940 census, Dr. Leon E. Truesdell; and Utilizing vital statistics in the public health program, Dr. Floyd P. Allen.

*Public Health Engineering.* The many joint meetings with which the engineers are concerned this year have limited their individual meetings to two. The Committees on Sewage Disposal and Shellfish, Chairmaned respectively by Langdon Pearse and L. M. Fisher, are reporting. Some observations on sanitary land-fills are made by Lewis V. Carpenter; Measures instituted for the control of *Aëdes egypti* are announced by James H. LeVan; A typhoid fever outbreak caused by "bootleg" oysters is reported by H. N. Old; The relationship of stream pollution abatement to Pittsburgh's water supply and health is traced by Dr. Chester F. Drake; The water pollution research program of the U. S. Public Health Service is reviewed by John K. Hoskins; and Certain aspects of governmental policy on stream pollution abatement are discussed by Dr. Herman G. Baity.

The Stag Dinner, social event of the meeting for engineers, will be held on Wednesday evening.

*Industrial Hygiene.* This Section is celebrating the 25th anniversary of its founding with a Silver Jubilee Dinner on Wednesday evening which promises to be a high spot socially, historically, and scientifically.

A luncheon session, at which Dr.

Henry Field Smyth, Sr., and Dr. Henry Field Smyth, Jr., will present reports of the Committees on Industrial Anthrax and Volatile Solvents, is of interest.

A symposium on field methods for rapid determination of air contaminants, with Dr. H. H. Schrenk specializing on dusts, Philip Drinker on vapors, and F. A. Patty on gases, is scheduled.

Other speakers listed are J. J. Bloomfield, Glenn S. Everts, Dr. Shirley W. Wynne, Dr. Robert H. Flinn, Theodore F. Hatch, and M. F. Trice. Their names follow the subjects: Address of the Chairman, Industrial hygiene for the smaller plant, Hearing and noise in industry, The dust problem in the pottery industry, The control of dust in rock drilling operations, and The dust hazard and its control in the foundry industry.

*Food and Nutrition.* Three individual sessions and a luncheon are planned.

Packaging of food products is approached from three standpoints. Dr. J. Raymond Sanborn takes the microbiological examination and standardization of paper wrappers and containers; Dr. Evan Wheaton the bacteriological problems relating to foods packed in paper containers; and the Committee on Milk and Dairy Products, Merrill J. Mack, Chairman, makes its report on the sanitary aspects of packaging milk and milk products.

Foods frozen in cold storage lockers and farm freezers are considered by the Committee on Foods, Dr. Donald K. Tressler, Chairman.

The new Food, Drugs and Cosmetic Act and its public health implications is the contribution of Walter S. Frisbie; Dr. Abraham Lichterman has a paper on trichinosis and its control; and William G. Walter one on distintegration methods for the bacterial examination of meat.

Milk figures prominently in several presentations. Nutritive and economic values of skim milk, economical milk products in human nutrition, and recent investigations of goat's milk are three papers to be read respectively by J. S. Abbot, Dr. Marietta Eichelberger, and Dr. Arthur K. Besley. The Burri Smear culture technic is described by Dr. B. W. Hammer.

The Oral Health Group as well as the Food and Nutrition Section will be interested in Dr. Mark Elliott's study on retardation of dental caries by dietary supplement and Dr. C. G. King's work on the effects of vitamin C intake upon tooth injury produced by diphtheria toxin.

Helen N. Church surveys the public health nutrition service in the United States; Dr. Walter H. Eddy asks what evidence there is of vitamin deficiency in the diet of the American people; Dr. Wilton L. Halverson talks on nutritional deficiencies in community groups with particular reference to vitamin B; and Dr. Morris Ant on the interpretation of nutritional factors in treating disease.

The luncheon session is devoted to reports of committees.

*Child Hygiene.* Experiences in rendering an obstetric delivery service in a rural area, stillbirths and neonatal deaths, a health department birth control program, a study of bacillary dysentery in rural areas, promotion of mental health, the development of a health education program, and advances made in the Federal program for the care of crippled children are subjects the Child Hygiene Section will cover in its two independent sessions and a luncheon meeting. The speakers are not yet announced, except for Dr. James Watt, who will present the dysentery paper.

*Public Health Education.* This Section announces frankly that its first session has been arranged particularly for new workers in the health education

field. The subject is equally frank—A reëvaluation of health education media. The debunkers are: Philip S. Broughton, who takes Printed Materials, Effective and Otherwise; Kenneth W. Grimley, with Newspapers and Magazines—Is Health News Fit To Print? Sally Lucas Jean, on Visual Aid Advances; Dr. W. W. Bauer, with Public Meetings—Are They Worth While? and Joseph Ries, with The Health Educator on the Radio.

" Frontiers in Medical Research and Advances in Science as they pertain to Health Education " is the title of the second session. Chemotherapy, mental hygiene, virus diseases, nutrition, and school dental health education are selected for this special attention; and the speakers, in the same order, are Dr. Jesse G. M. Bullowa, Dr. Emerson North, Dr. Ralph S. Muckenfuss, Dr. C. G. King, and Dr. Florence B. Hopkins.

The status, plans, and policies of the Section will be discussed at a dinner meeting. One luncheon is scheduled with Dr. Owsei Temkin speaking on the subject " Health Education Through the Ages."

*Epidemiology.* Four individual sessions with a wide range of topics are planned. Dr. Harold W. Brown presents the problem of malaria mortality, and Dr. Harry Most presents studies on malignant malaria in drug addicts. Dr. Thomas B. Turner calls attention to the factors which influence the interpretation of discovery rates in syphilis.

There are addresses by Drs. Donald T. Fraser, William Grossman, J. A. Doull, D. G. Gill, Martin Frobisher, Jr., Ernest L. Stebbins, and G. Foard McGinnes on the important diphtheria carrier survey.

Drs. Miriam Brailey, George W. Weber, and L. L. Lumsden are responsible for three tuberculosis papers entitled respectively "A Study of Mortality in the Children of Tuberculosis Households," " Tuberculosis in a Controlled Environment," and " Epidemiological Studies of Tuberculosis."

The epidemiology of " San Joaquin " or " Valley Fever " is described by Dr. Charles Edward Smith, of anthrax in North Dakota by Dr. John A. Cowan, and of three outbreaks of infectious jaundice by Dr. John J. Shaw. Jaundice in Detroit engages Dr. J. G. Molner; tick paralysis, Dr. R. B. Jenkins; and the modes of spread of respiratory infections, William F. Wells.

*Public Health Nursing.* The first of the two sessions on this program is devoted to reports of committees plus a discussion by Frances R. Pratt of the staff education programs for public health nurses developed by the North Carolina State Board of Health. The Committees reporting are: Relationships between official and non-official public health nursing agencies, Julia L. Groscop, Chairman; Industrial Nursing in and around Pittsburgh, Helen V. Stevens, R.N., Chairman; and Sub-Committee on Public Health Nursing of the Committee on Administrative Practice, Marion W. Sheahan, R.N., Chairman. Brief reports of representatives of the Public Health Nursing Section on Association Committees are also scheduled.

The second session lists Reba F. Harris for a paper on coördination of educational programs for all health workers, Anna Heisler, R.N., and Beryl Lussow, R.N., presenting respectively the rural and city agency viewpoint on the continuous educational program which supervision of public health nurses is. Dr. Iago Galdston discusses " Changes in Public Health Nursing Functions as a Result of New Medical Discoveries."

Dr. Edward S. Godfrey, Jr., is the speaker at a luncheon session. His subject is " Relation of the State Division of Public Health Nursing to Local Agencies."

### OTHER MEETINGS

During the week numerous administrative and technical committees and other groups will meet. Many are holding breakfast, luncheon, or dinner conferences. An event of special importance is the dinner of the Pennsylvania Public Health Association on Wednesday evening, to be followed by a meeting to which the public is invited. The speakers scheduled for this meeting are Dr. Henry F. Vaughan and Dr. Arthur T. McCormack.

It is to be emphasized that the foregoing is a summary of the scientific program. For the sake of brevity, titles are shortened in most instances and sometimes rephrased. Names of collaborating authors are omitted. The final and official program, to be distributed at the Registration Desk in Pittsburgh, will give full credit to coauthors and will report titles accurately and completely.

# ASSOCIATION NEWS

## SIXTY-EIGHTH ANNUAL MEETING
Pittsburgh, Pa., October 17–20, 1939

HEADQUARTERS — HOTEL WILLIAM PENN

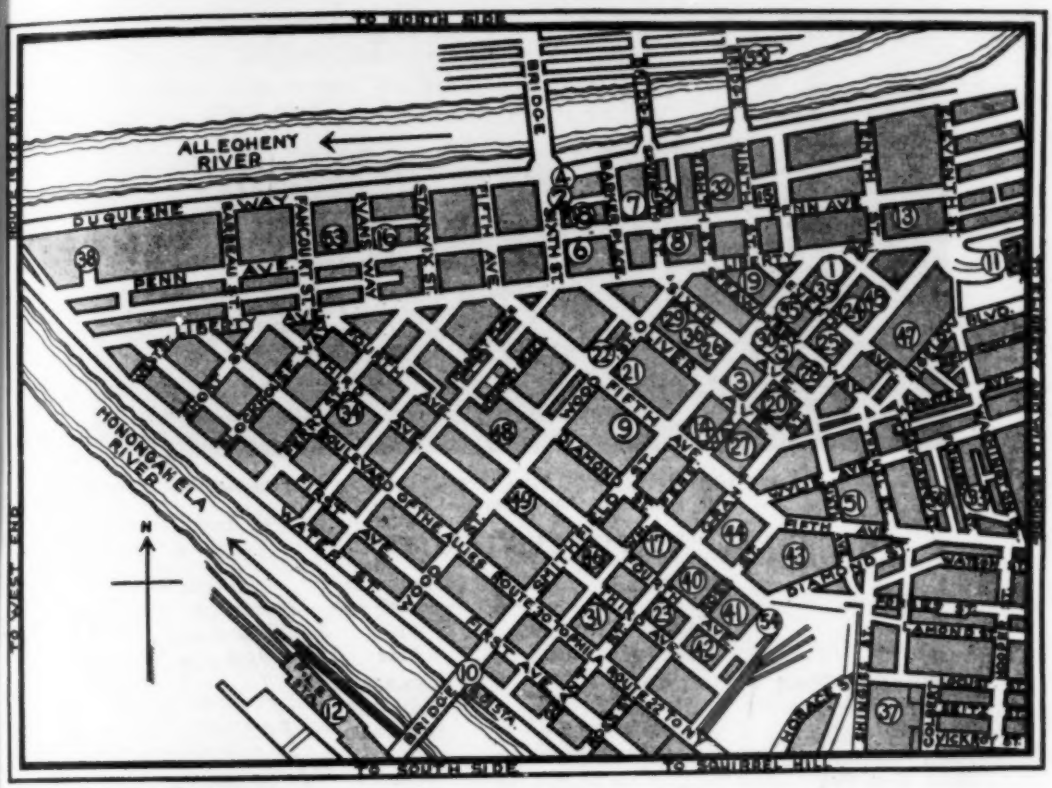
### RAILROAD FARES FROM VARIOUS POINTS TO PITTSBURGH, PA.

AMERICAN PUBLIC HEALTH ASSOCIATION
OCTOBER 17–20, 1939

| *From* | *One-way Pullman Travel* | *Round-trip Pullman Travel* | *One-way Lower* | *One-way Upper* |
|---|---|---|---|---|
| Atlanta, Ga.[1] | $23.75 | $42.50 | $5.80 | $4.40 |
| Baltimore, Md. | 9.05 | 18.10 | 2.65 | 2.00 |
| Boston, Mass. | 20.10 | 40.20 | 4.50 | 3.40 |
| Buffalo, N. Y. | 7.75 | 15.50 | 2.65 | 2.00 |
| Chicago, Ill. | 14.10 | 28.20 | 3.15 | 2.40 |
| Cleveland, Ohio | 3.95 | 7.90 | 2.10 | 1.60 |
| Dallas, Tex. | 38.24 | 64.50 | 10.00 | 7.60 |
| Denver, Colo. | 45.16 | 74.80 | 10.80 | 8.20 |
| Detroit, Mich. | 8.85 | 17.70 | 2.65 | 2.00 |
| Duluth, Minn. | 27.77 | 48.75 | 6.30 | 4.80 |
| Fort Worth, Tex. | 38.24 | 65.80 | 10.00 | 7.60 |
| Indianapolis, Ind. | 11.15 | 22.30 | 3.15 | 2.40 |
| Jacksonville, Fla.[2] | 32.76 | 57.60 | 8.40 | 6.40 |
| Kansas City, Mo. | 26.90 | 48.90 | 6.30 | 4.80 |
| Louisville, Ky. | 12.80 | 25.60 | 3.15 | 2.40 |
| Los Angeles, Calif. | 79.65 | 118.50 | 19.70 | 15.00 |
| Memphis, Tenn.[1] | 24.20 | 43.40 | 6.30 | 4.80 |
| Milwaukee, Wis. | 16.65 | 32.05 | 3.15[3] | 2.40 |
| Minneapolis, Minn. | 26.31 | 46.55 | 5.80 | 4.40 |
| Nashville, Tenn.[1] | 18.52 | 33.75 | 4.50 | 3.40 |
| New Orleans, La.[1] | 34.50 | 58.30 | 8.40 | 6.40 |
| New York, N. Y. | 13.15 | 26.30 | 3.15 | 2.40 |
| Omaha, Nebr. | 29.01 | 50.65 | 6.30 | 4.80 |
| Philadelphia, Pa. | 10.45 | 20.90 | 2.65 | 2.00 |
| Portland, Ore. | 78.44 | 118.50 | 19.70 | 15.00 |
| Salt Lake City, Utah | 58.89 | 87.55 | 13.95 | 10.60 |
| San Francisco, Calif. | 79.65 | 118.50 | 19.70 | 15.00 |
| Seattle, Wash. | 78.44 | 118.50 | 19.70 | 15.00 |
| St. Louis, Mo. | 18.55 | 37.10 | 4.50 | 3.40 |
| Washington, D. C. | 9.05 | 18.10 | 2.65 | 2.00 |
| Montreal, Que.[4] | 21.00 | 42.00 | 5.55 | 4.20 |
| Halifax, N. S.[4] | 41.95 | 83.90 | 9.30 | 8.00 |
| Ottawa, Ont.[4] | 20.00 | 40.00 | 5.55 | 4.20 |
| Quebec, P. Q.[4] | 26.65 | 53.30 | 5.55[5] | 4.20 |
| Toronto, Ont.[4] | 11.50 | 23.00 | 2.65[6] | 2.00 |
| Vancouver, B. C. | 78.44 | 118.50 | 19.70 | 15.00 |

1. Via Cincinnati
2. Via Washington
3. Pullman to Chicago only
4. Via Buffalo
5. Pullman to Montreal only
6. Pullman to Buffalo only

# THE GOLDEN TRIANGLE
## PITTSBURGH, PA.




*Courtesy of This Week in Pittsburgh*

### SHOWN ON THE MAP

**THEATERS**

1—Senator
2—Alvin
4—Fulton
5—Nixon
6—Penn
7—Barry
8—Stanley
9—Warner
Art Cinema (Liberty & Eighth St.)

**RAILROAD STATIONS**

10—Baltimore & Ohio
11—Pennsylvania
12—Pgh. & Lake Erie
54—Fourth Ave. Station

**HOTELS**

13—Fort Pitt
17—Pittsburgher
18—Roosevelt
20—William Penn
Keystone, Wood Street

**PRINCIPAL BUILDINGS**

21—Farmers Bank
22—First National Bank
23—Grant
24—Gulf
25—Koppers
26—Oliver
27—Union Trust
55—Heinz Plant
Jenkins Arcade (Liberty & Penn)

**CHURCHES**

28—First Lutheran
29—First Presbyterian
30—German E. P.
31—Salvation Army
32—Second Presbyterian
33—St. Peter's
34—St. Mary's Catholic
35—Smithfield M. E.
36—Trinity

**PUBLIC BUILDINGS**

37—Duquesne University
38—Block House
39—Chamber of Commerce
40—City-County
41—New County
42—County Morgue
43—County Jail
44—Court House
45—Federal Reserve
46—Old U. S. Post Office
47—New U. S. Post Office
48—Pgh. Stock Exchange
49—Y.M.C.A.
50—Y.W.C.A.

"The Golden Triangle" and the "Point." The junction of the Allegheny and Monongahela Rivers to form the Ohio

## PITTSBURGH HOTELS

| *Hotel* | *Room Capacity* | *Single Room* | | *Double Room* | |
|---|---|---|---|---|---|
| | | *Without Bath* | *With Bath* | *Without Bath* | *With Bath* |
| William Penn Hotel | 1,800 | | $3.50–$5.00 | | $5.00–$8.00 |
| Roosevelt Hotel | | | 2.50– 3.00 | | 4.00– 4.50 |
| The Pittsburgher | 400 | | 3.00– 4.00 | | 4.50– 6.00 |
| Hotel Schenley | | | 3.50– 4.50 | | 6.00– 8.00 |
| Hotel Fort Pitt | | $1.50–$2.00 | 2.50– 3.50 | $3.00 | 3.50– 6.00 |
| Hotel Webster Hall | 600 | $2.00 | 2.50– 3.50 | | 5.00– 7.00 |
| Hotel Keystone | | | 2.50– 3.00 | | 4.00– 7.00 |

**.....(Cut off on this line and mail to the hotel of your choice).....**

HOTEL RESERVATION BLANK FOR THE PITTSBURGH MEETING
AMERICAN PUBLIC HEALTH ASSOCIATION
OCTOBER 17–20, 1939

To .....
(Name of Hotel)

Please reserve for me ..... rooms for ..... persons for the A.P.H.A. Meeting.

Single room ..... Double room .....

Maximum rate per day for room $..... Minimum rate per day for room $.....

I expect to arrive ..... If date of arrival is changed I will notify you at least 24 hours in advance.

Please acknowledge this reservation.

Name .....

Street address .....

City ..... State .....

## NOMINATIONS FOR THE GOVERNING COUNCIL

IN accordance with the By-laws of the Association, the Nominating Committee reports the following nominations for the Governing Council. The Constitution provides that "upon the petition of twenty-five Fellows, the Nominating Committee shall add the name of any Fellow to this list, providing such petition is received fifteen days before the Annual Meeting." The *Chairman* of the Committee is Dr. John J. Sippy, San Joaquin Local Health District, Stockton, Calif.

The ten Fellows receiving the highest number of votes on a written ballot cast by the Fellows present and voting at the Annual Meeting in Pittsburgh, Pa., will be elected for the three year term 1939–1942.

Gaylord W. Anderson, M.D.
University of Minnesota
Minneapolis, Minn.

J. N. Baker, M.D.
State Health Officer
Montgomery, Ala.

J. Howard Beard, M.D.
University of Illinois
Urbana, Ill.

Malcolm R. Bow, M.D.
Deputy Minister of Health
Edmonton, Alberta, Canada

Selwyn D. Collins, Ph.D.
U. S. Public Health Service
Washington, D. C.

George B. Darling, Dr.P.H.
W. K. Kellogg Foundation
Battle Creek, Mich.

Robert D. Defries, M.D.
Connaught Laboratories and School of Hygiene
Toronto, Ontario, Canada

J. Clarence Funk, Sc.D.
State Department of Health
Richmond, Va.

Hugh N. Heffernan
State Board of Health
New Orleans, La.

Anna Heisler, R.N.
U. S. Public Health Service
San Francisco, Calif.

A. Parker Hitchens, M.D.
University of Pennsylvania
Philadelphia, Pa.

A. J. Lanza, M.D.
Metropolitan Life Insurance Company
New York, N. Y.

Karl F. Meyer, Ph.D.
Hooper Foundation
University of California
San Francisco, Calif.

Hugo Muench, Jr., M.D.
Rockefeller Foundation
New York, N. Y.

Harry S. Mustard, M.D.
New York University College of Medicine
New York, N. Y.

Bernard E. Proctor, Ph.D.
Massachusetts Institute of Technology
Cambridge, Mass.

Domingo F. Ramos, M.D.
Instituto Finlay
Havana, Cuba

George H. Ramsey, M.D.
Westchester County Department of Health
White Plains, N. Y.

W. S. Rankin, M.D.
Duke Endowment
Charlotte, N. C.

Robert H. Riley, M.D.
State Department of Health
Baltimore, Md.

Anna E. Rude, M.D.
Los Angeles County Health Department
Los Angeles, Calif.

Dean Franklin Smiley, M.D.
Cornell University
Ithaca, N. Y.

Elizabeth C. Tandy, D.Sc.
Children's Bureau
U. S. Department of Labor
Washington, D. C.

L. R. Thompson, M.D.
National Institute of Health
Washington, D. C.

Elnora E. Thomson, R.N.
University of Oregon Medical School
Portland, Ore.

Felix J. Underwood, M.D.
State Health Officer
Jackson, Miss.

W. Frank Walker, Dr.P.H.
Commonwealth Fund
New York, N. Y.

H. A. Whittaker
State Board of Health
Minneapolis, Minn.

Robert E. Wodehouse, M.D.
Department of Pensions & National Health
Ottawa, Ont., Canada

Hans Zinsser, M.D.
Harvard Medical School
Boston, Mass.

## APPLICANTS FOR FELLOWSHIP

*In accordance with the By-laws of the Association, the names of applicants for Fellowship are officially published herewith. They have requested affiliation with the Sections indicated. Action by the various Section Councils, the Committee on Eligibility, and the Governing Council will take place between now and the time of the Pittsburgh Annual Meeting.*

*Health Officers Section*

Joseph I. Linde, M.D., Health Officer, New Haven, Conn.

*Laboratory Section*

Natale Colosi, Ph.D., Director of Laboratories and Supt., Parkway Hospital, New York, N. Y.

Elizabeth J. Cope, B.S., Bacteriologist, Department of Health, Detroit, Mich.

George McL. Lawson, M.D., Dr.P.H., Professor of Preventive Medicine and Bacteriology, Department of Medicine, University of Virginia, Charlottesville, Va.

Stuart Mudd, M.D., Professor of Bacteriology, University of Pennsylvania Medical School, Philadelphia, Pa.

George T. Stevens, Director, Clinical Laboratory, U. S. Marine Hospital, San Francisco, Calif.

*Vital Statistics Section*

Sterling S. Cook, M.D., Dr.P.H., Chief of Medicine, Norfolk Naval Hospital, Portsmouth, Va.

Halbert L. Dunn, M.D., Ph.D., Chief, Division of Vital Statistics, Bureau of the Census, Washington, D. C.

Albert G. Love, M.D., Dr.P.H., Vital Statistical Division, U S. Army, Washington, D. C.

John T. Marshall, Director, Division of Vital Statistics, Provincial Board of Health, Victoria, B. C., Canada

John R. Miner, Sc.D., Associate Editor, Mayo Clinic, Rochester, Minn.

Leonard V. Phelps, S.B. in P.H., Director, Bureau of Vital Statistics, State Department of Health, Montgomery, Ala.

Ruth R. Puffer, A.B., Statistician, State Department of Public Health, Nashville, Tenn.

Franklin H. Reeder, M.B., Ch.B., State Registrar of Vital Statistics, State Health Department, Charleston, W. Va.

Lida J. Usilton, A.M., Senior Statistician, U. S. Public Health Service, Washington, D. C.

John M. Wheelis, Jr., M.D., Dr.P.H., Medical Officer, U. S. Navy, San Pedro, Calif.

Richard N. Whitfield, M.D., State Director of Vital Statistics, State Board of Health, Jackson, Miss.

Jacob Yerushalmy, Ph.D., Statistician, National Institute of Health, U. S. Public Health Service, Bethesda, Md.

*Industrial Hygiene Section*

Warren A. Cook, A.B., Division of Industrial Hygiene and Engineering Research, Zurich General Accident and Liability Insurance Company, Chicago, Ill.

Charles C. Dills, M.S., Industrial Hygiene Engineer, State Board of Health, Lawrence, Kans.

Henry F. Smyth, Jr., Ph.D., Industrial Fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa.

*Food and Nutrition Section*

William F. Reindollar, Sc.D., Chief, Bureau of Chemistry, State Department of Health, Baltimore, Md.

*Child Hygiene Section*

Adrian L. Carson, Jr., M.D., Assistant Director, Bureau of Maternal and Child Health, State Department of Health, Richmond, Va.

Edwin F. Daily, M.D., Director, Maternal and Child Health Division, Children's Bureau, Washington, D. C.

*Public Health Education Section*

Claude W. Chamberlain, Ph.D., Supervisor of Health Education, State Department of Public Health, Springfield, Ill.

William W. McFarland, M.D., Executive Director, General Health Council, Pittsburgh, Pa.

Charles E. Shepard, M.D., Professor of Hygiene and Director of Student Health, Stanford University, Calif.

*Public Health Nursing Section*

Henrietta M. Adams, R.N., M.S., Associate Professor and Director of Nursing Education, School of Nursing, University of Washington, Seattle, Wash.

Kathleen M. Logan, R.N., Supervisor of Nurses, Rutherford County Health Department, Murfreesboro, Tenn.

Helen C. Manzer, R.N., Ph.D., Associate Professor of Education and Director of Curricula in Nursing Education, School of Education, New York University, New York, N. Y.

Frances C. Montgomery, R.N., M.A., Professor of Public Health Nursing, College of William and Mary, Richmond, Va.

Dorothy Rood, Ph.D., Associate Professor and Director of Public Health Nursing, Loyola University, Chicago, Ill.

Beatrice Short, R.N., B.S., Superintendent, Indianapolis Public Health Nursing Association, Indianapolis, Ind.

Edith L. Soule, R.N., Director, Division of Public Health Nursing, State Bureau of Health, Augusta, Me.

Helen V. Stevens, R.N., B.S., Director, Public Health Nursing Association of Pittsburgh, Pittsburgh, Pa.

*Unaffiliated*

Fred L. Moore, M.D., C.P.H., Associate Professor of Preventive Medicine and Community Health, Long Island College of Medicine, Brooklyn, N. Y.

James L. Neff, Executive Secretary, Nassau County Medical Society, Mineola, L. I., N. Y.

George St. J. Perrott, M.A., Statistician, U. S. Public Health Service, Washington, D. C.

## APPLICANTS FOR MEMBERSHIP

***The following individuals have applied for membership in the Association. They have requested affiliation with the sections indicated.***

*Health Officers Section*

Samuel R. Berenberg, M.D., Medical Center, Greenbelt, Md., Director, Dept. of Public Health

Bryson E. Cox, M.D., 226 North 5th St., Coalinga, Calif., Health Officer and School Physician

W. W. Crook, M.D., Stone Bath House, Glenwood Springs, Colo., Garfield County Health Officer

Isbin S. Giddens, M.D., Millen, Ga., Commissioner of Health, Jenkins County Health Dept.

Harold W. Hackler, M.D., Poplar, Mont., Senior Physician, U. S. Indian service

Charles C. Hedges, M.D., Health Dept., Savannah, Ga., City-County Health Officer

James M. Hershey, M.D., D.P.H., Pouce Coupe, B. C., Canada, Director, Peace River Health Unit

John M. Hooper, M.D., Public Health District #1, Floydada, Tex., Director

Wilbur T. Little, M.D., 903 Macon Ave., Canon City, Colo., Fremont County Health Officer

John L. Reiger, M.D., Box 121, Craig, Colo., City-County Health Officer

Earl A. Rogers, M.D., Madison, Nebr., Medical Director, District Health Unit #2

Wyatt E. Roye, M.D., Box 747, Covington, Va., Health Officer

Wixom S. Sibley, M.D., U.S.P.H.S., 14th Ave. & Lake St., San Francisco, Calif., Assistant Surgeon

William O. Whitaker, M.D., Box 1, Creede, Colo., City-County Health Officer

O. F. Whitman, M.D., Box 193, Statesboro, Ga., Commissioner of Health, Bullock County Health Dept.

*Laboratory Section*

M. Elmer Christensen, B.S., 35 State Capitol, Salt Lake City, Utah, State Chemist

Bernice U. Eddie, M.A., Hooper Foundation for Medical Research, Medical Center, San Francisco, Calif., Instructor in Research Medicine

C. Virginia Fisher, Ph.D., Warner Institute, 113 W. 18 St., New York, N. Y., Bacteriologist

Donald M. Hetler, Ph.D., Montana State University, Missoula, Mont., Professor of Bacteriology & Public Health

Ruby S. Hirose, Ph.D., Wm. S. Merrell Co., Lockland Station, Cincinnati, Ohio, Biologist

Lois E. Hoar, B.S., Montana State Tuberculosis Sanitarium, Rt. 1, Deer Lodge, Mont., Laboratory Technician

Evelyn L. Kuehn, 303 N. Ewing St., Helena, Mont., Laboratory Technician, St. Peter's Hospital

Elizabeth Maltaner, B.S., 388 New Scotland Ave., Albany, N. Y., Associate Bacteriologist, Division of Laboratories and Research, New York State Dept. of Health

Mrs. Frances Martin, 318 Hickory St., Anaconda, Mont., Medical Technologist

Granville M. Neal, B.S., 23 Marden St., Cranston, R. I.

Arthur W. O'Donnell, B.S., 837–9 Ave., Helena, Mont., Serologist, State Board of Health

Edith M. Rich, M.S., Biology Dept., Trinity College, Washington, D. C., Teacher of Bacteriology

Walter A. Tschirgi, B.S., 516 W. Clev St., Bozeman, Mont., Research Assistant, Department of Bacteriology, Montana State College

Albert L. Vadheim, Jr., B.A., State Board of Health, Helena, Mont., Technician, Hygienic Laboratory

Julia Vinograd, M.D., 18–45 21 Road, Astoria, L. I., N. Y., Bacteriologist, Bureau of Laboratories, New York City Dept. of Health

Donald E. Warner, B.S., Box 339, Helena, Mont., Sanitary Inspector, State Board of Health

*Vital Statistics Section*

Lewis Conrad, B.S., State Board of Health, Helena, Mont., Fiscal Agent

*Public Health Engineering Section*

William H. Edwards, Jr., C.E., 1406 Mozley Place, S.W., Atlanta, Ga., Sanitary Engineer, Dept. of Health

Leonard H. Ledford, Sandersville, Ga., Sanitarian, Washington County Health Dept.

*Industrial Hygiene Section*

David Schlein, M.D., 416 N. Wood Ave., Linden, N. J., Toxoid Administrator, Dept. of Health

*Child Hygiene Section*

Stuart W. Adler, M.D., 221 West Central, Albuquerque, N. M., Pediatrician

Abraham H. Kantrow, M.D., 12–26 31 Ave., Astoria, L. I., N. Y., Assistant Director, School Health Study

C. Heyden Phillips, M.D., 200 S. Franklin St., Wilkes Barre, Pa., Director, Maternal and Child Health, District #1

*Public Health Education Section*

Mrs. Elizabeth Atwood, Browning, Mont., Field Nurse, U. S. Indian Service

Arthur E. Bagley, 44 Gramercy Park, New York, N. Y., Director, Metropolitan Life Exhibit, New York World's Fair

Rudolf C. Bertheau, A.B., 50 West 50 St., New York, N. Y., Secretary, American Eugenics Society

Ruth N. Crawford, B.S., C.P.H., 719 Hamilton St., Allentown, Pa., Executive Secretary, Lehigh County Tuberculosis Society

Clarence W. Davis, M.A., 606 Gresham Place, N.W., Washington, D. C., Teacher of Health Education, Howard University

Esther S. Horine, A.B., 2 N. Beechwood Ave., Catonsville, Md., Editorial Assistant, Public Health Education, Baltimore Health Department

Alma L. Jakoubek, R.N., 120 4 Ave., Apt. 7, Havre, Mont., School Nurse, Board of Education

Guido Ruiz-Moreno, M.D., Cerrito 1517, Buenos Aires, Argentine, S. A., Professor of Physiology, Girls High School

Jack Saylin, A.B., 508½ Forest Ave., Los Angeles, Calif., Medical Social Worker, Health Dept.

Fred L. Shoenberger, 5 E. Long St., Columbus, Ohio, Secretary, Ohio Dairy Products Association

*Public Health Nursing Section*

Henrietta Crockett, Box 65, Helena, Mont., Secretary, Montana Tuberculosis Association

Evelyn W. Gilcrest, B.S., C.P.H., 1010 Cragmont, Berkeley, Calif., Director of Nursing Service, Health Dept.

Jean Hand, R.N., 29 Cedar Ave., Towson, Md., Public Health Nurse, Baltimore County Health Dept.

Aagot Hoyendahl, R.N., Box 242, Hamilton, Mont., County Nurse

Wilhelmina C. Ihrig, Johnson, Nebr., Nurse

E. Doris Johnson, R.N., 1001 Atwater Ave., Bloomington, Ind., Supervisory Nurse, State Board of Health

Bertha E. Jutras, R.N., 109 Woodbine St., Cranston, R. I., Consultant in Public Health Nursing, State Dept. of Health

Aagot Lian, Ekalaka, Mont., County Nurse

Irene McQuistion, R.N., Greenfield, Mo., Public Health Nurse

Mary M. Morris, R.N., Mount Vernon, Mo., Public Health Nurse

Henrietta M. Schoenbeck, R.N., 809 Lake Blvd., St. Joseph, Mich., School Nurse, Board of Education

Montrose L. Williams, 1884–7 Ave., Apt. 64, New York, N. Y., Staff Nurse, Community Service Society

*Epidemiology Section*

Granville W. Larimore, M.D., 2129 N. Dayton St., Chicago, Ill., Assistant Medical Superintendent, Hospital Section, Board of Health

George W. Setzer, M.D., Malta, Mont., City-County Health Officer

*Unaffiliated*

George B. Davis, M.D., 29 Whitfield St., Guilford, Conn., Graduate Student, Dept. of Public Health, Yale Medical School

Charles T. Snyder, M.D., 1100 Park Ave., New York, N. Y.

## DECEASED MEMBERS

Miss Grace Abbott, Chicago, Ill., Elected Member 1929

Roy R. Jones, M.D., Washington, D. C., Elected Member 1935

Harry A. Simrell, M.D., Stockton, Mo., Elected Member 1938

## CLOSING DATE FOR ACCEPTING FELLOWSHIP APPLICATIONS

NOTICE is hereby given to any interested members that September 1 is the closing date for accepting Fellowship applications for 1939 election.

Eligible members wishing to apply for Fellowship this year should submit their completed applications as much in advance of this date as possible.

# EMPLOYMENT SERVICE

The Employment Service will register persons qualified in the public health field without charge.

Replies to these advertisements, when keyed, should be addressed to the American Public Health Association, 50 West 50th Street, New York, N. Y., identifying clearly the key number on the envelope.

## Position Available

The Board of Health of Tulsa, Oklahoma, will receive applications from trained and experienced physicians for the full-time position of Superintendent of Health. (See page 975.) Qualified applicants should communicate with Dr. Ned R. Smith, Oakwood Sanitarium, Rural Route 6, Tulsa.

## Positions Wanted

Physician, experienced in health administration of cities and states, will consider attractive opening in maternal and child health or health education. **A343**

Physician; M.D., University of Cincinnati; with postgraduate training in venereal disease control, Johns Hopkins; is available as venereal disease control officer. **A363**

Physician; M.D., Syracuse University; postgraduate studies in bacteriology and immunology; will consider position as health officer or epidemiologist. Has served as director of county health unit, director of industrial hygiene and medical statistics and venereal disease field survey officer. **A305**

Well qualified physician; M.D., Rush; M.S.P.H., University of Michigan; with three years' residence in tuberculosis, and special interest in venereal disease control; seeks responsible appointment. Excellent references. **A406**

Experienced physician, administrator, epidemiologist and teacher, now employed, with C.P.H. from Johns Hopkins, and 14 years' public health background, will consider position. Prefers epidemiology in city or state department. Excellent references. **A355**

Physician; M.D., Vanderbilt University; Dr.P.H., Johns Hopkins; experienced as epidemiologist, health officer and professor of preventive medicine; seeks position as administrator or epidemiologist. **A397**

Physician, aged 30; M.D., University of Illinois; C.P.H., University of California; experienced as instructor in medicine and director of state division of epidemiology; desires position in communicable disease control or administration. **A399**

### HEALTH EDUCATION

Health educator, with excellent background of teaching experience in schools; M.S.P.H., University of Michigan; wishes a position where skill with educational sound film projection and other recognized technics will be appreciated. **H405**

Young woman, with C.P.H. from Massachusetts Institute of Technology and broad experience in the health education field, consisting of consulting service to schools, in-service training of teachers, and health education coördination, desires position as health education coördinator or as a teacher of health education. **H428**

### LABORATORY

Broadly experienced laboratory director with excellent background, now employed southern state, seeks responsible position in laboratory work or teaching of bacteriology, immunology and pathology. **L426**

Bacteriologist, aged 30, Ph.D., 1938; special experience and research in anaerobic bacteriology; experienced in hospital and out-patient laboratory work and in teaching; seeks position in commercial or public health laboratory. **L424**

Woman bacteriologist; B.A., Chemistry, 1933; 5 years' experience in experimental and practical therapeutics including animal work; desires position in public health field. **L394**

Bacteriologist and serologist, recently graduated from the University of Michigan with M.S.P.H., seeks position with promise. Willing to start modestly. **L425**

Bacteriologist, aged 33, with training in serology; for the past 4 years bacteriologist in charge, public health laboratory; will consider opening. **L427**

### MISCELLANEOUS

Young woman physician, M.D., M.S., D.Sc., desires position in public health work or medical research, particularly in the field of pediatrics or child hygiene. Now resident in pediatrics. Several years research experience in parasitology and medical zoölogy. **C429**

# Situations Open

ASSOCIATE PROFESSOR PUBLIC HEALTH—Physician in thirties with special training and experience in preventive medicine preferred; good research record advantageous; $3,000–$4,000; university medical school. 80-PH, Medical Bureau, Pittsfield Building, Chicago.

PUBLIC HEALTH PHYSICIAN—Eastern physician, experienced public health or administration; work entirely administrative; $4,000. 81-PH, Medical Bureau, Pittsfield Building, Chicago.

SCHOOL PHYSICIAN—Recent graduate contemplating public school health service as life work; duties include some teaching and dispensary service for students; eastern university; $200. 82-PH, Medical Bureau, Pittsfield Building, Chicago.

PUBLIC HEALTH PHYSICIAN—Southern college; enrollment averages a thousand, including faculty. 83-PH, Medical Bureau, Pittsfield Building, Chicago.

SCHOOL PHYSICIAN—Must be familiar with public health problems, eligible Washington licensure; excellent connection. 84-PH, Medical Bureau, Pittsfield Building, Chicago.

SCHOOL NURSE—Graduate nurse, preferably of mature years, for appointment in school enrolling principally boys of junior-senior high school grade from rural districts; duties light; must be Protestant. 85-PH, Medical Bureau, Pittsfield Building, Chicago.

SCHOOL NURSE—Exclusive school for girls, with average enrollment of 100; duties will include complete charge infirmary, some teaching and chaperoning; graduate nurse, 30–35, preferably Protestant, desired; location near eastern cultural center. 86-PH, Medical Bureau, Pittsfield Building, Chicago.

PUBLIC HEALTH NURSE—For combination appointment including care of children in small day nursery and visiting insurance policy holders in restricted area; hours 8–5; $125, private office, car and car maintenance; must be certified. 87-PH, Medical Bureau, Pittsfield Building, Chicago.

SCIENCE INSTRUCTOR—Qualified to teach public health in school of nursing; 600-bed hospital; midwestern metropolis. 88-PH, Medical Bureau, Pittsfield Building, Chicago.

# Situations Wanted

PUBLIC HEALTH NURSE—Particularly interested in executive position in clinic or public health field; graduate of teaching hospital; B.S. in public health nursing; graduate courses in public health at Western Reserve and Columbia; several years' executive experience in public health nursing; four years, director of large clinic; for further information, please write M. Burneice Larson, Director, Medical Bureau, Pittsfield Building, Chicago.

HEALTH EDUCATOR—Graduate nurse and B.S. degrees; social service certificate; three years' experience in social service; four years, industrial nursing; ten years, director of a health council; for further details, please write M. Burneice Larson, Director, Medical Bureau, Pittsfield Building, Chicago.

BACTERIOLOGIST — B.A., eastern school; C.P.H. and Ph.D. (bacteriology), Yale University; has done considerable research; four years, bacteriologist and research technician, public health laboratories; desires appointment in public health laboratories; for further details, please write M. Burneice Larson, Director, Medical Bureau, Pittsfield Building, Chicago.

PUBLIC HEALTH PHYSICIAN—Desires connection; M.D., Virginia; several years' successful private practice; ten years' public health work during which time he has been promoted continuously; excellent reason for relocating; for further details, please write M. Burneice Larson, Director, Medical Bureau, Pittsfield Building, Chicago.

# NEWS FROM THE FIELD

## ADVISORY COUNCIL ON MEDICAL EDUCATION

AN Advisory Council on Medical Education came into being on June 24 in Chicago, when 11 national organizations concerned with the training of physicians to meet the present day needs of medical care for the country recognized the necessity for some central representative agency to make medical training more effective. Willard C. Rappleye, M.D., Dean of the Faculty of Medicine at Columbia University College of Physicians and Surgeons, was elected President. Dr. Rappleye pointed out that this organization for the first time brings together various national bodies dealing with all phases of the training and licensing of physicians, beginning with the preparatory college work and including medical education, hospital internship, residency, licensure, and graduate training for specialization.

The American Public Health Association is represented on the Advisory Council on Medical Education through W. S. Leathers, M.D., Dean and Professor of Preventive Medicine and Public Health, School of Medicine, Vanderbilt University, Nashville, Tenn., and Chairman of the Committee on Professional Education of the American Public Health Association. Other organizations represented are the Association of American Medical Colleges, the American Hospital Association, the Catholic Hospital Association, the American Protestant Hospital Association, the Association of American Colleges, the Federation of State Medical Boards of the United States of America, the Advisory Board for Medical Specialties, the National Board of Medical Examiners, the American College of Physicians, the American College of Surgeons, the Association of American Universities, and the American Association for the Advancement of Science, Division of Medical Sciences.

Among the problems considered by the Council at its meeting were those of educational standards for the hospital internship, adequate training for the specialist, sound programs for the continued education of physicians in practice, modifications in college preparation for medical studies, the simplification of the procedure for licensure in the 48 separate states and the status of training of graduates of foreign medical schools.

## DEDICATION OF AMERICAN MUSEUM OF HEALTH, INC.

ON Saturday, June 17, 1939, many physicians, public health officials, medical scientists, educators, and other prominent persons participated in ceremonies dedicating the American Museum of Health, Inc. The exercises were held in the Hall of Man of the Medicine and Public Health Building at the New York World's Fair.

With generous support from the Carnegie Corporation of New York, the Rockefeller Foundation, the Oberlaender Trust, and the major life insurance companies, this Museum has created or acquired most of the exhibits in the Medicine and Public Health Building. At the end of the Fair period, it will add to and maintain these displays in a permanent health teaching center in the City of New York. Coöperation in securing a building to house its activities has been assured by several public officials, including Mayor Fiorello H. LaGuardia, a director of the Museum.

Among the speakers at the dedication ceremonies were: Abel Wolman, Dr.Eng., Edward S. Godfrey, M.D., Louis I. Dublin, Ph.D., Homer N.

Calver, John L. Rice, M.D., Mayor LaGuardia, Frederick Osborn, Livingston Farrand, M.D., and George Baehr, M.D.

### DR. ROBERT H. RILEY HONORED FOR TWENTY-FIVE YEARS OF SERVICE

ON July 5th the employees of the Maryland State Department of Health gave a testimonial banquet to Dr. Robert H. Riley, in honor of the 25 years since he joined the Department. The *Baltimore Sun* editorially points out that under Dr. Riley's leadership Maryland became the first of the 48 States to place its entire rural population under the protection of full-time local health officers. Credit is also given to Dr. Riley for the development of a statewide network of branch public health laboratories.

### TULSA SEEKS COMPETENT SUPERINTENDENT OF HEALTH

THE City of Tulsa, Okla., population 141,000 plus 35,000 in surrounding metropolitan areas, has recently recast its public health program through an ordinance which provides for a non-partisan health board to have jurisdiction over all public health work. It is expected that this set-up eventually will become a coöperative program between the city and county, and the health work in the public schools may also be included.

The new program is based on a public health survey recently completed under the auspices of certain of the city officials. The program is said to have the full approval and complete coöperation of the Tulsa County Medical Society which shared in promoting its consideration. It is announced that the immediate problem of the Board of Health is to secure a competently trained, experienced full-time superintendent of health and that the Board will receive applications from qualified persons for this position.

### DR. STAMPAR AT UNIVERSITY OF CALIFORNIA

DR. Andriya Stampar, Professor of Social Medicine, State University, Zagreb, Yugoslavia, has been named to the newly created post of Rosenberg Professor in the Public Social Sciences at the University of California, Berkeley. Dr. Stampar will be the first to hold the position, which was created by a gift from the Rosenberg Foundation of San Francisco. A graduate of the University of Vienna, Dr. Stampar formerly served as Director of Health of Yugoslavia. He was adviser on health matters to the National Government of the Chinese Republic from 1933 to 1936, when he became expert on health matters to the health section of the League of Nations. He was a visiting lecturer under the Rockefeller Foundation in the United States in 1938.

While on the Berkeley campus he will give two courses, one for graduate students and one for upper division students. He will also deliver a series of public lectures on the campus, and, by special conditions of the Foundation grant, will be enabled to visit other parts of the state for lectures and consultations, according to the *Journal of the American Medical Association* of July 1, 1939.

### MARYLAND LAW REGARDING HEALTH COMMISSIONERS

EFFECTIVE June 1, 1939, a new law in Maryland provides for the appointment of the Director of the State Department of Health by the State Board of Health rather than by the Governor as in previous years.

The new law makes the Commissioner of Health of the City of Baltimore ex-officio one of the nine members of the State Board of Health, and Dr. Robert H. Riley is designated as the Director of Health, to continue in this capacity indefinitely, subject

only to competent performance. It is provided that the Director of Health must be an experienced physician, skilled in public health and hygiene, and he may be removed by the Board of Health only for incompetency or misconduct in the same manner as civil officers receiving appointment from the Executive for a term of years.

### CANADIAN PUBLIC HEALTH ASSOCIATION

OFFICERS of the Canadian Public Health Association have been elected for 1940 as follows:

*Honorary President:* The Hon. J. M. Uhrich, M.D., Regina (Minister of Health, Province of Saskatchewan)

*President:* Dr. R. O. Davison, Regina (Deputy Minister of Public Health, Saskatchewan)

*Vice-Presidents:* Dr. Grant Fleming, Montreal (Dean, Faculty of Medicine, McGill University); Dr. Jean Gregoire, Quebec (Deputy Minister, Ministry of Health of Quebec); Dr. J. J. McCann, Renfrew, Ontario (Medical Officer of Health, Renfrew); Miss Elizabeth L. Smellie, C.B.E., Ottawa (Chief Superintendent, Victorian Order of Nurses for Canada)

*Honorary Secretary,* Dr. J. T. Phair, Toronto (Chief Medical Officer of Health, Province of Ontario)

*Associate Secretary,* Dr. A. H. Sellers, Toronto (Medical Statistician, Department of Health of Ontario)

*Honorary Treasurer,* Dr. A. L. McKay, Toronto (Department of Health of Ontario)

*Chairman of the Editorial Board,* Dr. R. D. Defries, Toronto (Associate Director, School of Hygiene and Connaught Laboratories, University of Toronto)

### BLOOD STUDY INSTITUTE

THE University of Wisconsin Medical School, Madison, has announced an Institute for the Consideration of the Blood and Blood-forming Organs, September 4–6. In addition to the consideration of many aspects of anemia, a section will be devoted to consideration of the anemias of nutritional deficiency, under the direction of Dr. George R. Minot, of the Harvard Medical School and the Thorndike Memorial Laboratory, Boston.

### NEW YORK CITY INDICTMENT DROPPED AGAINST COMMISSIONERS OF HEALTH AND SANITATION

ON April 4 a Grand Jury of the Borough of Queens returned indictments against several individuals and companies including John L. Rice, M.D., Commissioner of Health, and William F. Carey, Commissioner of Sanitation, charging that land fill dumps of waste and garbage at various points were a nuisance and that they endangered public health and safety. A change of venue to Bronx County was granted on May 16, and on June 19 the New York State Supreme Court dismissed the indictments under an agreement to let an impartial commission arbitrate the matter. Under the terms of this agreement, Dr. Thomas Parran will appoint a board of five, consisting of four physicians outstanding in health work and an experienced sanitary engineer, to make an investigation and examination of the land fills maintained by the Department of Sanitation.

This board was asked by the Court not only to decide whether the land fills were a menace to public health and safety but to suggest possible improvements, even if they were not found to be a menace. Subsequently, Dr. Thomas Parran, according to the press, announced the appointment of the following: Eugene L. Bishop, M.D., C.P.H., Milton J. Rosenau, M.D., Huntington Williams, M.D., Dr.P.H., Kenneth F. Maxcy, M.D., Dr.P.H., and Ralph E. Tarbett, C.E.

### JOHNS HOPKINS UNIVERSITY DEPARTMENT OF PREVENTIVE MEDICINE

THE Dean of the Johns Hopkins Medical School, Baltimore, has announced that the Rockefeller Foundation has appropriated funds covering a ten year plan to establish a department of preventive medicine in the amount of $350,000.

### INTERNATIONAL CONGRESS FOR MICROBIOLOGY

THE Third International Congress for Microbiology will be held in New York at the Waldorf-Astoria Hotel, September 2–9, 1939. More than six hundred papers on a variety of subjects will be presented, including papers on bacterial variation and taxonomy, microbiological chemistry and physiology, viruses and viral diseases, rickettsias and rickettsial diseases, fungi and fungous diseases (including bacterial diseases of plants), protozoölogy and parasitology, medical and veterinary bacteriology (including chemo- and sero-therapy), industrial and agricultural microbiology, and immunology.

Anyone interested in these subjects may attend the meetings. A registration fee of $5.00 will be charged. Those wishing to attend would do well to communicate with the treasurer, Dr. Kenneth Goodner, Rockefeller Institute, York Avenue and 66th Street, New York, N. Y.

### PUBLIC HEALTH WEEK OBSERVATION IN NEW JERSEY

THE Bergen County [N. J.] Medical Society sponsored a Public Health Week, beginning May 14, in coöperation with public health groups. Exhibits were shown at various hospitals.

A meeting was held under the auspices of the woman's auxiliary to the county society in Hackensack on May 19, with Haven Emerson, M.D., of New York, as the speaker on "Organized Care of the Sick and Public Health in Relation to 'Socialized Medicine.'" The motion picture "The Birth of a Baby" was shown in Hackensack on May 20 to invited groups. The week was concluded, on May 21, with the dedication of an "orthopedic pool" at the Bergen County Hospital, presented by the American Legion.

### NEW HEALTH OFFICER IN MICHIGAN

THE appointment of A. J. Moyer, M.D., of Charlotte, Mich., as State Health Officer, succeeding Don W. Gudakunst, M.D., Dr.P.H., effective August 1, has been announced by the Governor.

### ARIZONA PUBLIC HEALTH ASSOCIATION OFFICIALS

AT its recent Annual Meeting the Arizona Public Health Association elected the following officers for 1939–1940:

*President*—W. W. Peter, M.D., Window Rock
*President-elect*—H. D. Ketcherside, M.D., Phoenix
*1st Vice-President*—O. W. Fowler, Phoenix
*2nd Vice-President*—Fred J. Baker, Flagstaff
*Secretary-Treasurer*—Marion E. Stroud, Phoenix

### GEORGIA PUBLIC HEALTH ASSOCIATION OFFICIALS

AT its recent Annual Meeting, the Georgia Public Health Association elected the following officers for the year 1939:

*President*—William H. Weir, Atlanta
*Vice-President*—Elizabeth Fulcher, Marietta
*Secretary-Treasurer*—Gordon T. Crozier, M.D., Valdosta

### MICHIGAN STATE COUNCIL OF HEALTH

NEW members of the Michigan State Council of Health, recently appointed by Governor Dickinson and confirmed by the Senate for terms of six years, include:

*President:* Henry F. Vaughan, Dr.P.H., Detroit
*Secretary:* John Lavan, M.D., Grand Rapids

A. D. Aldrich, M.D., Houghton
Carleton Dean, M.D., Charlevoix
Roy C. Perkins, M.D., Bay City

This Council serves in an advisory capacity to the State Health Commissioner.

### OHIO FEDERATION OF PUBLIC HEALTH OFFICIALS

THE Ohio Federation of Public Health Officials held its Annual Convention in Columbus on May 19, 1939, at which time the following officers were elected for 1939:

*President*—Dr. H. H. Pansing, Dayton, O.
*Vice-President*—Dr. E. H. Schoenling, Cincinnati, O.
*Secretary-Treasurer*—Dr. W. D. Bishop, Greenville, O.
*Delegate to A.P.H.A.*—Dr. G. D. Lummis, Middletown, O.
*Alternate*—Leo F. Ey, Columbus, O.

## PERSONALS

### Central States

GEORGE E. ADAMS, Deputy Registrar of Vital Statistics for the City of Milwaukee, Wis., for 29 years, and a Health Department employee for 53 years, has retired.

DR. JOHN K. ALTLAND, of Allegan, Mich., has been appointed Director of the newly created health unit in Traverse County.

GREGOIRE F. AMYOT, M.D., D.P.H.,* who has been Administrative Associate of State Health Studies conducted by the Committee on Administrative Practice of the American Public Health Association, has accepted an appointment during the fall and winter quarters of the coming academic year in the Department of Preventive Medicine and Public Health at the University of Minnesota, Minneapolis. Dr. Amyot will have charge of the formal instruction in public health administration.

ALBERT C. BAXTER, M.D.,† Acting Director of the Illinois State Department of Health since 1937, has been appointed head of the Department.

DR. WILLARD G. BEATTIE, of Ferndale, Mich., resigned as City Health Officer, effective May 15, to devote his time to private practice.

PHILIP E. M. BOURLAND, M.D., M.S.P.H.,† of Iron Mountain, Mich., has resigned as Director of the Dickinson County health unit.

RUTH E. BOYNTON, M.D.,† Associate Professor of Preventive Medicine and Public Health, University of Minnesota Medical School, Minneapolis, Minn., has been appointed to the State Board of Health.

HERMAN N. BUNDESEN, M.D.,* who has been on a leave of absence since November, 1938, has returned to his activities as Health Commissioner and President of the Board of Health of Chicago.

GEORGE A. DUNDON, B.J.,* Director of Statistics and Health Education, of the Department of Health, has been appointed Deputy Registrar of Vital Statistics for the City of Milwaukee, Wis., succeeding GEORGE E. ADAMS, retired.

BURT A. DYAR, M.D., of Pierre, S. D., has been appointed full-time secretary of the State Interallied Professional Council, which represents the medical, dental, nursing, hospital, and pharmaceutical associations.

DR. DARREL L. EVANS, of Manhattan, Kans., recently resigned as Health Officer of Riley County.

DR. EDWIN H. FEDERMAN, of Montello, Wis., has been appointed Health Officer of Eau Claire County.

DR. PERCY A. PETITT, of Paola, Kans., has been appointed Health Officer of Miami County.

EDWIN H. PLACE, M.D.,† of Midland, Mich., who has been attending the University of Michigan School of Public Health on a leave of absence, has resigned as Health Officer of Midland County. Dr. Place has accepted a fellowship for study in

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* Fellow A.P.H.A.
† Member A.P.H.A.

public health with the Kellogg Foundation of Battle Creek.

HARVEY J. SKARSHAUG, M.D.,† of Fargo, N. D., has resigned as City Health Officer.

DR. ALFRED R. SORENSON, of Minot, N. D., has been appointed City Health Officer, succeeding DR. JOHN L. DEVINE.

### Eastern States

ALFRED J. ASGIS, D.D.S.,† of New York, N. Y., had the degree of Ph.D. conferred upon him at the June commencement at New York University.

MERLE R. FRENCH, M.D.,* who has been for several years Commissioner of Health for Cortland County Department of Health, Cortland, N. Y., has resigned, effective September 1, to become Health Director of Van Buren County, Paw Paw, Mich.—one of the counties participating with the W. K. Kellogg Foundation in a special health program.

PROFESSOR IRA V. HISCOCK,* of the Department of Public Health, Yale University, New Haven, Conn., was awarded an honorary Doctor of Science degree at the June commencement of Wesleyan University, Middletown, Conn.

DR. ALFRED NEWTON RICHARDS, Professor of Pharmocology at the University of Pennsylvania, Philadelphia, Pa., has been elected Vice-President of the University in charge of medical affairs and in this capacity will have supervision of the teaching in public health to graduate and undergraduate students newly organized under A. Parker Hitchens, M.D.,* Pepper Professor of Preventive Medicine and Public Health.

HANS ZINSSER, M.D.,* was awarded the honorary degree of Doctor of Science by both Yale University and Harvard University at the June Commencement exercises.

### Southern States

DR. LEE SCOTT BARKSDALE, of Richmond, Va., has been appointed Health Officer of Hopewell.

DR. CHARLES E. CATCHINGS, of Woodville, Miss., was recently named Health Officer of Wilkinson County, to fill the unexpired term of DR. EDWIN M. BUTLER, of Centerville, who has been appointed Health Officer of Union County.

DR. JOHN W. DORMAN, of Holly Springs, Miss., was recently placed in charge of the Marshall County Health Department, succeeding GUY R. POST, M.D.,† who went to Clarksdale.

DR. JOHN W. FRANCIS, of Perry, Okla., has been appointed Health Superintendent of Noble County.

GEORGE L. HALL,† of Baltimore, Md., Acting Chief Engineer of the Bureau of Sanitary Engineering for some years, has been appointed Chief Engineer of the Maryland State Department of Health, succeeding ABEL WOLMAN, DR.ENG.,* resigned.

DR. RAYBURN N. JOYNER, of Marianna, Fla., has resigned as Director of the Jackson County Health Department, to enter private practice.

DR. JAMES A. SPROLES, JR., formerly of Jackson, Miss., has been appointed Health Officer of Amite County.

ABEL WOLMAN, DR.ENG.,* Professor of Sanitary Engineering, Johns Hopkins University, Baltimore, retired as Chief Engineer of the Maryland State Department of Health, effective July 1. On that date he became Consulting Engineer to the State Board of Health and to the State Department of Health.

WILLARD H. WRIGHT, D.V.M., PH.D.,† has been appointed Chief of the

* Fellow A.P.H.A.
† Member A.P.H.A.

Division of Zoölogy in the National Institute of Health, U. S. Public Health Service, Washington, D. C., succeeding the late MAURICE C. HALL, PH.D., D.V.M.†

DEATHS

P. P. CAUSEY, M.D.,† of Courtland, Va., Health Officer of Southampton County, died on June 5.

HOYT E. DEARHOLT, M.D.,* Executive Secretary of the Wisconsin Anti-Tuberculosis Association, Madison, Wis., died July 12.

ALFRED FRIEDLANDER, M.D.,† Dean of the College of Medicine, University of Cincinnati, Cincinnati, Ohio, died May 28.

WILLIAM F. LUNSFORD, M.D., M.P.H.,† for the last 3 years City Health Director of Kansas City, Kans., died July 4, in Nevada, Mo., from the results of an automobile crash. He was 41 years old.

## CONFERENCES AND DATES

American Association for the Advancement of Science. Annual Meeting —Columbus, Ohio, December 27, 1939–January 2, 1940.

American Congress of Physical Therapy. Hotel Pennsylvania, New York, N. Y. September 5–8. (Following Seminar in Physical Therapy for Physicians and Technicians, August 30–September 2.)

American Congress on Obstetrics and Gynecology—sponsored by the American Committee on Maternal Welfare, Inc. Municipal Auditorium, Cleveland, Ohio. September 11–15.

American Dietetic Association—22nd Annual Meeting. Hotel Ambassador, Los Angeles, Calif. August 27–31.

**American Public Health Association. 68th Annual Meeting. Hotel William Penn, Pittsburgh, Pa. October 17–20.**

American School Health Association. Hotel William Penn, Pittsburgh, Pa. October 16–20.

American Society of Civil Engineers—Fall Meeting. New York, N. Y., September 4–9.

American Standards Association. New York, N. Y. November 30–December 1–2.

American Statistical Association—Annual Meeting. Philadelphia, Pa. December 27–30.

Association of Dairy, Food and Drug Officials of the United States—43rd Annual Conference. Hartford, Conn. September 26–29.

Association of Women in Public Health. Century Club, Pittsburgh, Pa. October 16.

Biological Photographic Association—9th Annual Convention. Mellon Institute for Industrial Research, Pittsburgh, Pa. September 14–16.

California Sewage Works Association —12th Annual Fall Convention. Oakland, Calif. September 18–19.

Colorado Public Health Association. Colorado Springs, Colo. October 3–4.

Convention for the Revision of the Pharmacopoeia of the United States. Washington, D. C. May 14, 1940.

Directors of Local Health Services Conference. Hotel Roosevelt, Pittsburgh, Pa. October 16.

Florida Public Health Association. Jacksonville, Fla. December.

Health Education Institute—American

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* Fellow A.P.H.A.
† Member A.P.H.A.

Public Health Association, Annual Meeting. Hotel William Penn, Pittsburgh, Pa. October 15–17.

Institute for the Consideration of the Blood and Blood-forming Organs. University of Wisconsin Medical School, Madison, Wis. September 4–6.

International Association for Identification. Tulsa, Okla. September 11–14.

International Association of Milk Sanitarians, Inc.—Annual Meeting. New Hotel Mayflower, Jacksonville, Fla. October 25–27.

International Cancer Congress—Third. Haddon Hall Hotel, Atlantic City, N. J. September 11–16.

International Congress of Microbiology —Third. Waldorf-Astoria Hotel New York, N. Y. September 2–9.

International Heating and Ventilating Exposition—Sixth. Under auspices of the American Society of Heating and Ventilating Engineers, and coinciding with its 46th Annual Meeting. Lakeside Hall, Cleveland, Ohio. January 22–26, 1940.

International Society of Medical Health Officers. Hotel William Penn, Pittsburgh, Pa. October 16.

Michigan Public Health Association. Lansing, Mich. November 1–3.

Mississippi Public Health Association. Jackson, Miss. December 6–8.

Municipal Public Health Engineers Conference. Hotel William Penn, Pittsburgh, Pa. October 16.

National Association for Nursery Education — Biennial Meeting. New York, N. Y. October 25–28.

National Association of Sanitarians. Oakland, Calif. December.

National Institute for Traffic Safety Training (Second). University of Michigan, Ann Arbor, Mich. August 14–26.

National Organization for Public Health Nursing. Hotel William Penn. Pittsburgh, Pa. October 15–16.

National Pest Control Association—7th Convention. Hotel Pennsylvania, New York, N. Y. October 23–25.

National Recreation Congress — 24th. Boston, Mass. October 9–13.

National Safety Congress and Exposition—28th. Atlantic City, N. J. October 16–20.

National Society for the Prevention of Blindness. Annual Conference. Hotel Astor, New York, N. Y. October 26–28.

National Warm Air Heating and Air Conditioning Association. Cleveland, Ohio. January 22–26, 1940.

New Jersey Health and Sanitary Association — 65th Annual Meeting. Berkeley-Carteret Hotel, Asbury Park, N. J. November 24–25.

Pacific Science Congress—Sixth. Under the auspices of the National Research Council. Oakland, Calif,. July 24–August 12.

Pan-Pacific Surgical Association—Third Congress. Honolulu, T.H. September 15–28.

Pennsylvania Public Health Association—Meeting with American Public Health Association. Hotel William Penn, Pittsburgh, Pa. October 18.

Southern California Public Health Association. Long Beach, Calif. January 24, 1940.

State Laboratory Directors Conference. Hotel William Penn, Pittsburgh, Pa. October 16.

State Sanitary Engineers Conference. Hotel William Penn, Pittsburgh, Pa. October 16–17.

Texas Public Health Association. Galveston, Tex. October 2–4.

Tri-State Food & Health Officials. Hotel William Penn, Pittsburgh, Pa. October 18.

West Virginia Public Health Association. Hotel Fairmont, Fairmont, W. Va. November 6–8.

**Canada**

International Hospital Association. Toronto, Ont. September 19–23.

American College of Hospital Administrators. Toronto, Ont. September 24–25.

American Hospital Association. Toronto, Ont. September 25–29.

FOREIGN

Fifth National Medical Congress of Uruguay. Montevideo, Uruguay. Summer of 1939.

Summer Course of Phthisiology. Under direction of Professor Eugenio Morelli. Carlo Forlanini Institute, Rome, Italy. July 15–October 15.

International Malaria Course for 1939. Under direction of Professor Giuseppe Bastianelli. Ettore Marchiafava Institute of Malariology, Rome, Italy. July 24–September 20.

World Federation of Education Associations, Eighth Biennial Congress. Rio de Janeiro, Brazil. August 6–11.

International Congress of Public Health and Public Safety. Liege, Belgium. August 12–15.

Third International Neurological Congress. Copenhagen, Denmark. August 21–25.

International Congress on Public Cleansing. Vienna, Austria. August 24–28.

Eighth Pan American Child Congress. San Jose, Costa Rico. August 28–September 4.

International Conference on Sewage Works and Disposal. Glasgow, Scotland. September 12–18.

Intergovernmental Conference of American Countries on Rural Hygiene. Mexico City, Mexico. End of 1939 (postponed from November 10, 1938).

International Management Congress. Stockholm, Sweden. September 19–23, 1941.


## Best Sellers in the Book Service *for* July

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| Handbook of Health Education—Ruth E. Grout | 2.00 |
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